Advancing Berkshire triticale supply for the Australian pig industry
4B-115

Final Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

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June 2014

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Executive Summary

Following the release of Berkshire triticale in Australia in 2009, it was expected that it would be prominent within the feed grain supply chain because it was relatively high yielding, agronomically suited to large parts of grain-growing regions in Australia, and contained about 0.5 MJ DE/kg more energy than the average level found in other triticale varieties. Even though wheat is a dominant crop, it is reasonable to assume that Berkshire would have a niche, as a superior triticale variety, in grain growers’ rotations.

It is economically rational for pig producers to source downgraded wheat at discounted prices but when supply is short, price will increase and pig producers may have to seek alternatives. As there is a relatively inelastic demand with respect to price for grains and they are the major component of animal feeds, it might be expected that pig producers would send demand signals to grain growers so as to increase their confidence in growing dedicated, high yielding feed grain varieties. Facilitating such communication could involve establishing supply chain networks and potential contracts.

The aim of this project was to provide a guide for and assessment of triticale supply chains that could be economically and environmentally efficient for the Australian pig industry in Western Australia (WA) and South Australia (SA).

In preparing the supply chain guide, knowledge gaps were identified and outputs were prepared and distributed to address this lack of information. However, in the assessment it was found that generally, communication within the supply chain appeared to be sufficient to facilitate growing and using Berkshire within the supply chain. Even so, demand for triticale in general, and specifically Berkshire, is spasmodic, with price incentives being limited due to a seemingly adequate supply of alternative grains. Further, supply of triticale is irregular and after poor seasons is unlikely to be grown unless the grain producer has ample resources to use it as a break crop or receives a price incentive to grow it. Closed-loop supply chains were not established and this was due in part to both (a) the grain producer having a lack of incentive to participate, and (b) the grain buyer/user overestimating production risk and underestimating price risk. However and in due course when supply of grains for feed is limiting, the advantages of a closed-loop supply chain for both pork producers and grain growers is likely to become evident.

To that end, the following recommendations have been made:

1. Endorse triticale varieties as energy substitutes for wheat to encourage triticale demand at a market price;
2. Should demand increase, encourage feed buyers to communicate with agronomists and triticale growers to stimulate supply;
3. In the short term, to increase the area grown of triticale and specifically Berkshire, the focus should be the “Grower-User” market segment involving mixed pork/grain businesses;
4. Remove the PBR status from Berkshire;
5. Follow the progress of triticale as a food grain and use any positive market developments to benefit feed grains;
6. A market awareness campaign for grain bought as feed and a workshop program focusing on price risk management and grain trading be made available for producers and buyers of grains purchased as feed for the pig industry;
7. To ensure security for grain used as feed, there is merit in testing the closed-loop supply chain concept again with a mainstream commodity such as wheat or barley;
8. The Pork CRC should not be involved in plant breeding of niche varieties.
# Table of Contents

Executive Summary ........................................................................................................... ii  
1. Introduction ..................................................................................................................... 1  
2. Methodology .................................................................................................................. 1  
3. Outcomes ...................................................................................................................... 2  
4. Application of Research ............................................................................................... 5  
5. Conclusion ..................................................................................................................... 6  
6. Limitations/Risks ......................................................................................................... 6  
7. Recommendations ....................................................................................................... 7  
8. References .................................................................................................................... 7  
9. Appendices ................................................................................................................... 7
1. Introduction

Following the release of Berkshire triticale in Australia in 2009, it was expected that it would be prominent within the feed-grain supply chain because it was relatively high yielding, agronomically suited to large parts of grain-growing regions in Australia, and according to King (2010) contained about 0.5 MJ DE/kg more energy than the average level found in other triticale varieties. Whilst Pluske and Pluske (2011) found that grain growers generally preferred wheat to triticale, because of its earlier harvesting date and higher yield and price, it was nevertheless expected that Berkshire would have a niche as a superior triticale variety.

With regard to demand, pig producers continue to source downgraded wheat at discounted prices (as previously noted by Barbetti et al. 2005). It may be economically rational for them to make such purchase decisions but when supply is short, price will increase and pig producers may have to seek substitute energy sources, including high-priced food manufacturing wheat. As grains are the major component of animal feeds and there is a relatively inelastic demand with respect to price for grains, it might be expected that pig producers should address this grain security issue. Part of this process should include enhancing grain growers’ confidence in growing dedicated, high-yielding grain varieties for the feed market. Grainsearch (2007) noted that a quality feed-grain industry in Australia would not develop if the end users did not help drive the process by ensuring there is a continuing competitive market place and price.

To this end, Barbetti et al. (2005) suggested that within relevant supply chain entities there needs to be: (a) an increase in the flow of information and understanding from farmers through to end-users; (b) a focus on demand and supply imbalances by e.g., establishing supply chain networks and potential contracts; and (c) feedback to meet agronomic and plant breeding requirements of industry funding bodies and the supply chain. Grainsearch (2007) noted that implementation of feed grain supply chain groups would need consideration of their specific requirements, capacities, strengths and weaknesses and hence a customised plan for each. These recommendations continue to be relevant in light of the current situation.

The aim of this project was to provide a guide for triticale supply chains that could be economically and environmentally efficient for the Australian pig industry in Western Australia (WA) and South Australia (SA). In addition, an assessment of these chains was to be completed to determine the likelihood of their success.

2. Methodology

In South Australia, consultants from Rural Directions who have expertise in grain agronomy and marketing developed a short supply chain initiative. In addition a pig liaison consultant, Graeme Pope, assisted this team with identifying potential workshop participants from the grain and pig industries. The overarching objective of the workshops was for producers from both industries to engage in the project and agree to contracts for supply and purchase of Berkshire. An announcement for expression of interests in the project was released in September 2012 (Appendix 1). Following this announcement, workshops were held for both grain growers and pig producers.

A longer supply chain system was devised for Western Australia involving grain growers, agronomists, grain marketers, feed buyers and pig producers, with the emphasis being on working within the existing supply chain. The first step was to
liaise with grain marketers to set up a plan for a Berkshire receival system that was economically and environmentally effective for the grain producer and feed manufacturer and to organize for the collection of end-point royalties. During the next phase involving liaison with agronomists it was recognized that there was not enough technical information available for them to make informed recommendations for Berkshire. Hence supplementary data concerning Berkshire, collected from Pork CRC Project 4B-103 1112, was used to write relevant information reports (Appendices 2 and 3). Included also in these reports were example gross margin analyses for comparisons between e.g., growing Berkshire and wheat. To supplement the WA report a fact sheet was written (Appendix 1). A press release was also written and released to coincide with producer meetings (Appendix 1). Meetings were had with feed and pig producers and due to the lack of nutritional information regarding Berkshire, grain analyses were completed (Appendix 4) and nutritionist, Daniel Goussac, completed three feed formulation scenarios with the aim of estimating a ‘value’ for Berkshire (Appendix 5). Due to the lack of transparency in the supply chain, a model was developed by Jo Pluske to estimate the quantity of Berkshire that may be available for feed buyers (Appendix 5).

Whilst structures were put in place to achieve the desired outcomes for this project, the methodology was flexible to account for variations that could arise due to the different outcome from various stages of the project. In SA there was initial willingness to engage in supply chains based on an average pricing model and a contract-farming model. However, the focus shifted to just one case study for each structure. Based on the procedure put in place and findings from these case studies an assessment of the Berkshire supply chain in SA was then completed (Appendix 6). In WA, the supply chain management model proposed was a committed marketing system whereby information regarding quantity of grain demanded and a price range are known to potential suppliers, with grain sold on the spot market. However, at the request of pig producers, a closed-loop structure was also put in place. Findings from this research were then incorporated in an assessment of the Berkshire supply chain in WA (Appendix 7).

3. Outcomes

This project was not able to validate production of up to 10,000 tonnes of Berkshire in each of SA and WA. However, the project contributed to raising the awareness of triticale across the supply chain and enabled a detailed assessment of the supply chains. The following draws on information from the Appendices and specifically from Appendices 6 and 7.

3.1. An assessment of the Berkshire supply chain

Agronomic evidence reviewed for this project indicated that it might be advantageous to grow Berkshire in a cropping rotation. However, there is a lack of trial data, specifically for WA, and in particular data showing for example a comparison of wheat and Berkshire on acidic soils. Findings also suggested that there were some reservations about what triticale variety to grow because none are specifically recommended for WA and, in other States, the messages are mixed, with for example Hart Bros recommending Fusion as their “pick” for a high yielding grain triticale¹. Further, wheat was perceived by grain producers as being less risky to grow and the expected gross margin was higher for wheat than for triticale. Hence it is likely that Berkshire will struggle to find a place in the rotation for most grain growers, unless the price paid for it is such that it is able

to complete with alternative crops, and there is some continuity of market demand.

WA pork producers were receptive to the idea of increasing the level of Berkshire in their pig diets and were keen to work with others in the supply chain. However, they were not able to be specific with regard to quantity and price. The general outcome was that Berkshire was viewed as a feed grain and so should be priced accordingly within that range. Most grain for feed in WA is bought on the spot market but producers were keen to develop a “Hectare-Based Berkshire” contract. Hence a WA company, Grain Link, released a contract for grain producers whereby price was based on APW2 highest average free-in-store price less $20/t between 9th December and 23rd December 2013 (with price to be confirmed 1st January 2014). However, there was very little interest in this contract on the part of grain producers and so contracts were not written for the 2013/14 season. The main reason for little interest was the lack of financial incentive for the grain producer.

In SA an average pricing model and a contract-farming model were developed as alternative marking arrangements to the spot market. A number of pork producers attended an information session on the Berkshire triticale supply-chain concept. Despite the interest, just one contract farming option was considered by a grain grower in the Mallee of SA and a pork producer in the lower north of SA. Given the variability in production in the Mallee environment and associated price fluctuations based on yield, as well as the impact of freight costs given distances involved, the pork producer chose not to continue with the option. This was because, in his view, he was bearing the majority of the risk with the arrangement. There was also a disincentive given the freight component, which could have been overcome by using a grain grower in closer proximity to the pork producer. There was also just one average pricing contract considered by a Berkshire grower and a pork producer. Despite the detailed average pricing model presented to them, the pork producer was reluctant to pay the suggested price. A non-verbal supplier-buyer arrangement was entered into and when the parties eventually conferred to determine a sale price, the spot market price was agreed upon.

Despite formal contract marketing arrangements being put into place to encourage Berkshire production, the deal breaker in each case was the price. Pork producers need to be convinced of the superior attributes of such a cultivar within their production system and need to be prepared to pay a competitive price from a grain grower’s perspective. Findings from this project suggested that triticale would be selected in a least-cost formulated ration at a higher price than producers were willing to pay. However, feed grain purchase decisions are principally driven by the goal of procuring energy at the lowest possible price and as triticale has traditionally been priced in the “feed grain” category, it will be difficult to change this mindset especially if there are substitutes available.

Known seed sales of Berkshire have taken place in WA and SA from 2009 to 2012. To date, however, there has not been an official ‘premium’ paid for Berkshire. Without expensive testing, it is also difficult to detect Berkshire from other triticale varieties. Hence there is little incentive on the part of the grower to declare a triticale crop as Berkshire. Due to this obscurity, the quantity of Berkshire in the supply chain remains ambiguous. Computer modeling for a WA scenario suggests that conservatively there may be between 3,000 and 5,000 tonnes of feed available with seed kept for 2,000 to 5,000 hectares. Whilst these figures are speculative, they provide an insight into what the current situation
regarding Berkshire in WA might be and the potential that could be reached with favourable conditions.

As there is little incentive to declare a variety as Berkshire by either the grower or buyer, the issue of whether the plant breeder’s rights (PBR) status should remain active on Berkshire is ripe for debate. To retain the PBR for Berkshire, an annual registration renewal fee must be paid for the protection period. Once the PBR has expired, the variety reverts to the public domain and is available to everybody. There have been 29 varieties of triticale registered for PBR in Australia with only 15 still having an active PBR status.

Additional supply options and (or) financial incentives such as those that might originate out of a food grain market may induce some enthusiasm in triticale production. Dennett et al. (2013) presented results of the baking characteristics and food value of triticale (including Berkshire). They concluded that there was potential for triticale to be used as a flour substitute to wheat for some goods. This research is particularly encouraging in that if there is a food market for triticale, the spin-off for the feed industry may be positive in terms of increased triticale supply.

Triticale is grown in WA and SA as an option for grain growers and buyers. Whilst it might grow well on acidic soils, grain growers are hesitant to grow it due to what they perceive to be a lack of financial incentive. Despite what feed formulations might suggest, buyers prefer to buy it at around $20 to $30/t less than what they are willing to pay for wheat. Given the grain-growing substitutes available, triticale growers are generally price takers and hence have little incentive to produce triticale.

If pig producers are serious about having triticale in their rations then they have to ensure supply. Evidence from this project suggested that pork producers naturally choose to continue to operate in the spot market for grain acquisition needs. For this to change, the industry may (unfortunately) need to experience a grain supply and price ‘shock’, where pork producers are perhaps forced to purchase grain at import parity prices. Such an event may force a change to attitudes.

Overall, it can be concluded that whilst there is adequate communication within the supply chain, demand for Berkshire is spasmodic with price incentives being limited due to seemingly adequate supply of alternative grains. Further, supply of triticale is irregular and after poor seasons is unlikely to be grown unless the grain producer has ample resources to use it as a break crop, or receives a price incentive to grow it. Failure to establish a successful closed-loop supply chain was due in part to the vehicle, Berkshire, having limitations from the grain grower’s perspective and also the buyer not being willing to accept responsibility for production risk. In addition, price risk associated with Berkshire seems to be underestimated. Despite this outcome, it should be noted that throughout the conduct of the project there was recognition of the advantages of a closed-loop supply chain approach in relation to feed grains and support for the broad concept from both pork producers and grain growers.

### 3.2. General outcomes and project outputs

This project has delivered:

- Desktop reports, that incorporated findings from Pork CRC Project 4B-103 1112, detailing Berkshire yield and DE in Western Australia and South Australia (Appendices 2 and 3).
- A nutritional profile for Berkshire (Appendix 4).
Notes for Berkshire value and tonnage (Appendix 5).
A report titled Advancing Berkshire triticale supply for the Australian pig industry: An assessment of the supply chain in SA (Appendix 6).
A report titled An assessment of the Berkshire supply chain system in WA (Appendix 7).
Papers presented at APSA 2013 (Appendix 8).

4. Application of Research

4.1. Application of the research findings in the commercial world

Currently the most likely market that currently exists for Berkshire remains with mixed pork/grain businesses where both a grain growing and a pork production enterprise are conducted.

Should a new high-energy grain variety become available for use in pig feed (e.g., there are 14 relatively new triticale varieties), it is not likely to be available in all regions nor is it likely to be a requirement in all pig diets. Generally the market is not currently sophisticated enough to ensure that the value of DE is reflected in prices, despite the technology (AusScan) existing. Hence any premiums are likely to arise only by negotiation of individual parties. Should such negotiations arise, supply of a particular variety would be more secure and pig producers may benefit from the higher energy content.

For this reason, and given the substantial cost of variety development, it is recommended that the Pork CRC should not be involved in plant breeding of niche varieties. It is envisaged that existing plant breeding programs of mainstream species and varieties will meet the feed grain needs for the pork industry.

4.2. Opportunities uncovered by the research

The current feed grain market that pork producers are operating in requires players to have knowledge, an appropriate skill set and tools to effectively manage grain price risk. An awareness campaign and follow-up skills development workshop program could be useful for Australian pork producers.

An awareness campaign could be used to highlight: (a) the risks associated with feed grain supply in Australia; (b) how the feed grain market operates; and (c) why price risk management is important. The role of a supply-chain relationship can be canvassed as a topic as part of the exercise. The awareness program could be delivered via articles in pork industry publications, the rural media and presentations at pork industry conferences and expos.

A workshop program could (also) be held around the country for producers wanting additional knowledge about grain purchasing. Topics such as principles of price risk management, development and maintenance of relationships within a supply chain, contract law and management, forward contracting, grain trade rules and the role of Grain Trade Australia, the use of grain swaps and other risk management products, and pricing models for feed grains within supply chains (including both rolling average and contract farming developed as part of this project), could be covered. Financial coaching support for individuals as well as facilitation of meetings between pork producers and grain growers could also be useful in properly developing supply chain arrangements for grains bought for feed. Further, and with regard to supply-chain development, there is merit in testing the supply-chain concept again, but with a mainstream commodity such as wheat or barley.
4.3. Adoption strategies

Feed buyers have indicated that there will always be a place for triticale in pig diets. Hence the conversation regarding supply of and demand for triticale should continue. In the current market atmosphere the *ad hoc* buying and selling strategies will continue, as there appears to be reasonable communication within the supply chain. However, once demand for grain for feed tightens then buyers will have to become more savvy in procuring grain. It is likely that they will need to adopt price risk management tools and become more transparent with the quantity that they want and be prepared to pay a price that is acceptable to the suppliers.

4.4. Research papers associated with this project


5. Conclusion

Whilst the project objective of facilitating production of up to 10,000 tonnes of Berkshire in WA and SA was not officially realized through this project, the assessments of the supply chain provided valuable information. Knowledge gaps were identified and outputs were prepared and distributed to address this lack of information. Generally, communication within the supply chain appeared to be sufficient to facilitate growing and using Berkshire within the supply chain. Even so, demand for Berkshire is spasmodic with price incentives being limited due to seemingly adequate supply of alternative grains. Further, supply of triticale is irregular and after poor seasons is unlikely to be grown unless the grain producer has ample resources to use it as a break crop or receives a price incentive to grow it. Failure to establish a successful closed-loop supply chain was perhaps due to an overestimation of production risk and an underestimation of price risk. However, in due course when supply of grains for feed is limiting the advantages of a closed-loop supply chain for both pork producers and grain growers will be evident.

6. Limitations/Risks

It was not possible to validate the quantity of Berkshire produced in WA or SA. However, based on simulation modeling it is quite possible that up to 10,000 t of Berkshire could be currently produced in WA.
7. **Recommendations**

As a result of the outcomes derived from this study the following recommendations have been made:

1. Endorse triticale varieties as energy substitutes for wheat to encourage triticale demand at a market price;
2. Should demand increase, encourage feed buyers to communicate with agronomists and triticale growers to stimulate supply;
3. In the short term, to increase the area grown of triticale and specifically Berkshire, the focus should be the “Grower-User” market segment involving mixed pork/grain businesses;
4. Remove the PBR status from Berkshire;
5. Follow the progress of triticale as a food grain and use any positive market developments to benefit feed grains;
6. A market awareness campaign for grain bought as feed and a workshop program focusing on price risk management and grain trading be made available for producers and buyers of grains purchased as feed;
7. To ensure security for grain used as feed, there is merit in testing the closed loop supply chain concept again with a mainstream commodity such as wheat or barley;
8. The Pork CRC should not be involved in plant breeding of niche varieties.

8. **References**


9. **Appendices**

1. Appendix 1: Information releases
2. Appendix 2: Berkshire Triticale in Western Australia
3. Appendix 3: Berkshire Triticale in South Australia
4. Appendix 4: Nutritional Profile of Berkshire
5. Appendix 5: Notes for Berkshire value and tonnage
6. Appendix 6: Advancing Berkshire triticale supply for the Australian pig industry: An assessment of the supply chain in SA
7. Appendix 7: An assessment of the Berkshire supply chain system in WA
8. Appendix 8: APSA 2013 Papers
PROJECT 4B- 115: ADVANCING BERKSHIRE TRITICALE SUPPLY FOR THE AUSTRALIAN PIG INDUSTRY

Appendix 1: Information releases

Final Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

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June 2014
The Flier written to supplement the agronomic information provided in the written report.

**Have you considered Berkshire Triticale?**

*It is desirable for dedicated feed grains to have...
* a comparable yield to varieties grown for food...
* agronomic characteristics similar to varieties currently grown by producers...
* a high digestible energy content...
* a competitive price....

**Objective:** To increase awareness of Berkshire triticale in the grain supply chain with the aim of increasing supply and demand.

* Trial results suggest that Berkshire can be competitive with existing wheat and barley varieties in terms of yield.

**Pork CRC Project: Advancing Berkshire triticale supply for the Australian pig industry**

- Average yields (t/ha) for Berkshire triticale and various wheat and barley varieties grown during the 2009/10 season at Margaret River, Western Australia.

Berkshire is suited to all soil types but can have a yield advantage over wheat and barley when grown in problem soil situations such as on acidic soils (pH less than 4.5CaCl2) that are high in aluminium (greater than 10% of the total cations) e.g. WA. Planting times and seeding rates are similar to wheat. When compared to wheat, it tends to be more competitive against ryegrass. For specific management, contact your local agronomist or see Waratah Seeds fact sheets at www.waratahseeds.com.au

* In 2009/10 WA trials, for Berkshire, the average DE was 13.78 MkJ/kg.

* Contact your local triticale trader to negotiate a competitive price for Berkshire.

A multidisciplinary project involving the CRC for High Integrity Australian Pork, Murdoch University, the Department of Agriculture and Food WA, and various members of the industry. For more information contact Professor John Flaske (jflaske@murdoch.edu.au) or Dr Bruce Nulan (bruncnan@agr.wa.gov.au)
Berkshire Triticale: it’s time for SA growers and users to get together

Several years ago Pork CRC collaborated with the University of Sydney to produce a high yielding triticale variety, Berkshire, with an average digestible energy (DE) of up to 13.9 kJ/kg DM or 34.8 MJ/tonne. This is around 0.5 MJ more than other triticale varieties, and pigs on the Berkshire Triticale performed as well or slightly better than those on wheat diets. The variety held a limited release in 2008, and stocks have since reached the level where it is available for more widespread commercial use.

According to the Westraid Seed Company, far businesses responsible for the commercialisation of Berkshire Triticale;

The SA Expression of Interest Announcement – September 2012

There should be no restriction on the vaccination level of Triticale in pig diets. Triticale composition and management may vary, but the key factor in the successful implementation of a triticale-based diet is the quality of the triticale itself. In addition, the test feed is expected to have a high content of protein and nitrogen.

South Australian pig producers and users are interested in hearing from you if you:

- Have © the use of a significant quantity of triticale in your pig diets;
- Have a unique ability to develop a long-term, mutually beneficial supply relationship with grain growers;
- Can produce such a relationship that does not develop properly if the grower is not prepared to develop.
- Have a network of suppliers based around the state.

If you are interested and would like to nominate or find out more, please contact Tony Creadock, Rural Direction, on 08 8670 6091, or send an email to t.creadock@ruraldirections.com.au.

PLC’s Pork CRC Group Housing Solutions Workshops

The Pork CRC and PLC are convening workshops to assist producers with the transition to piglet-free production. They will be held on 26th-27th October in the area around the state. The workshops will focus on the changing landscape of the Australian and the world, and identifying factors that make the process sustainable and affordable.

For more information or to register, please visit PLC’s Pork CRC Group Housing Solutions Workshops at www.pork CRC.com.

Protos Hand Pig Handling Course offered in October at Murray Bridge

This course is offered to the industry at no cost thanks to support from the Pig Industry Fund.

Protos Hand Pig Handling Course offered in October at Murray Bridge

This course is offered to the industry at no cost thanks to support from the Pig Industry Fund.

If you are interested and would like to nominate or find out more, please contact Tony Creadock, Rural Direction, on 08 8670 6091, or send an email to t.creadock@ruraldirections.com.au.

Emergency Disease Watch Hotline: 1800 675 888

For more information, contact the Pork CRC at 08 8670 6091 or email info@pork CRC.com.au.
Berkshire Triticale A Growing Grain Option In 2013

Last season Dawson Bradford grew 500 hectares of Berkshire triticale at ‘Hillcroft Farms’ at Popanyinning in Western Australia’s Great Southern, where he mills all the feed for his 700 sow piggery.

An exclusive supplier of pigs to leading WA smallgoods manufacturer D’Orsogna Ltd., Mr Bradford must maximise his feed conversion ratio, hence being able to utilise Berkshire’s high digestible energy content of up to 13.9 MJ DE/kg (about 0.5 MJ DE/kg more than the average energy in other triticale varieties) is a big production plus.

To manage problems with frost, inherent in all triticale varieties, he planted Berkshire on high ground and to extend the flowering window beyond the September frost risk period grazed it from late June to early July.

Having trialled it now for four years, Mr Bradford has found he can sow late and graze without any yield penalty. After harvest straw is used for pig bedding or sold for export.

“I’ve achieved yields above three tonnes per hectare and while it hasn’t out performed barley here, it has done better than wheat,” Mr Bradford said.

He particularly values Berkshire’s agronomic traits and its flexible sowing date.

Berkshire triticale was bred through the Pork CRC to be a high yielding grain with a higher digestible energy content than contemporary varieties. It yields well, especially on an energy basis and supports excellent growth performance in pigs.

With financial backing from the pork industry, via the Pork CRC, the variety is now commercially available for planting in 2013.

Murdoch University Professor John Pluske, who leads a Pork CRC project to increase awareness of Berkshire triticale throughout the supply chain, said that because triticale was not widely grown in WA, it may not be an obvious crop for grain growers to consider in their rotations.

“Hence, we’ve been talking with grain growers, agronomists, grain buyers, feed manufacturers and pork producers about Berkshire because we believe it has benefits for the pig industry and also for the grain industry,” Professor Pluske said.

Long-term NVT trials in eastern Australia indicate Berkshire is a leading triticale variety.

While there wasn’t NVT data for Berkshire in WA, independent trails in the 2009/10 and 2010/11 seasons, showed average yields across several sites compared well to established wheat varieties, indicating Berkshire could be important as a break crop.

“Berkshire’s ability to handle acidic and waterlogged soils gives grain growers an alternative option for these soils, but also because it has performed well across soil types it could be considered as a replacement for wheat in some years,” Professor Pluske said.

If interested in Berkshire triticale or would like more information about the project, please contact Professor John Pluske by email J.Pluske@murdoch.edu.au

www.porkcrc.com.au

Authorised by Pork CRC and issued on its behalf by
Brendon Cant, Tel 08 9731 6739.

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PORK CRC PROJECT 4B - 115: ADVANCING BERKSHIRE TRITICALE SUPPLY FOR THE AUSTRALIAN PIG INDUSTRY

Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

APPENDIX 2: BERKSHIRE TRITICALE IN WESTERN AUSTRALIA

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December 2012
Executive Summary

The CRC for an Internationally Competitive Pork Industry identified feed grains and pulses as a research priority (Program 1). In particular, research was directed towards breeding varieties of grains and pulses that could be grown in major pig production areas with the aim of securing more reliable and consistent energy (and protein) supplies for the formulation and manufacturing of pig diets. The expected outcomes of the research were a reduced variation in the annual cost of pig feed; a reduced total cost of pig feed; a wider range of feed ingredients available to more producers; and a closer match of diet specifications to pig requirements. To that end, a number of plant breeding projects were commissioned for the generation of new wheat, barley, triticale, and (or) pea varieties that contained favourable characteristics for the pig industry, such as a higher digestible energy (DE) content.

The overall aim of this report was to present data obtained from independent plant breeding trials to show the relative performance of Berkshire (triticale), a PBR variety, in relation to a selection of grains currently available for commercial production. This report focuses on trial results from Western Australia, and in this regard, we submit that judging the performance of a variety of grain from only one or two years of data should be viewed with some caution. For example, for the 2010/11 season at the Meckering trial site, the yield for Mace was 88% of that for Berkshire whereas for the 2009/10 season it was 114% of the Berkshire yield. However, the yield (with relatively low variance) for Berkshire across sites for each year was competitive with that of the wheat varieties.

A simple gross margin analysis was presented to provide an indication of how Berkshire compares to wheat. In locations and seasons where Berkshire outperforms wheat by for example 20%, it is possible (contingent upon prices) that it will produce a greater return than wheat. Further, the agronomic benefits from growing Berkshire may result in it being an attractive alternative for grain growers.

The finding that there was a range in DE of 0.5 MJ/kg for the 2009/10 season and 0.25 MJ/kg for the 2010/11 season for Berkshire grown at different sites may be significant for pig feed manufacturers. Further, a variation of 0.3 MJ/kg for Berkshire grown at one site over two seasons may add to this significance.

Whilst outside the scope of this project, it would have been useful to have data regarding soil type to help explain some of the findings. In addition, information related to agronomic advantages of growing Berkshire as a break crop would also be useful for grain producers.

This report indicated that it is possible for Berkshire to yield well when compared with conventional wheat and barley varieties grown in Western Australia. Whilst trial sites were not specifically allocated to acidic soils, it is possible that Berkshire could out-perform alternative crops on such soils. Hence grain producers may consider it as a break crop or as an option for acidic soils.

In terms of DE of Berkshire, it would appear that there are differences between seasons and sites. Hence it may be to their advantage for feed manufacturers and end users to consider these differences when evaluating and buying grain.
Table of Contents

Executive Summary ............................................................................................................................ i
List of Figures ........................................................................................................................................ iii
List of Tables........................................................................................................................................ iv
1. Introduction ........................................................................................................................................ 1
2. Methodology ...................................................................................................................................... 1
   2.1. Trial Site Management ..................................................................................................................... 1
   2.2. Trial Site Locations .......................................................................................................................... 1
   2.3. DE Data ......................................................................................................................................... 3
3. Outcomes .......................................................................................................................................... 3
   3.1. The 2009/10 Season ........................................................................................................................ 3
   3.2. The 2010/11 Season ........................................................................................................................ 7
   3.3. An Example Gross Margin Analysis ............................................................................................... 10
4. Application of Research ..................................................................................................................... 11
5. Conclusion ....................................................................................................................................... 11
6. References ....................................................................................................................................... 12
List of Figures

Figure 1 The pig producing areas of Australia (shaded) and the crop trial sites for the 2009/10 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005). ................................................................. 2

Figure 2 The pig producing areas of Australia (shaded) and the trial sites for the 2010/11 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005). ................................................................. 3

Figure 3 Yields of Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA .................................................................................................................... 4

Figure 4 Yields as a percentage of Berkshire for various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA .................................................................................................................... 5

Figure 5 Average yields (t/ha) for Berkshire triticale and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA ................................................................. 5

Figure 6 Average DE (MJ/kg) for Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA ........................................................................................................... 6

Figure 7 DE (MJ/kg) for Berkshire grown during the 2009/10 season at the specified trial sites in WA ................................................................. 6

Figure 8 Yields of Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in WA ....................................................................................................................... 7

Figure 9 Yields as a percentage of Berkshire for various wheat varieties grown during the 2010/11 season at the specified trial sites in WA ........................................................................................................... 8

Figure 10 Average yields (t/ha) for Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in WA ........................................................................................................... 8

Figure 11 Average DE (MJ/kg) for Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in WA ........................................................................................................... 9

Figure 12 DE (MJ/kg) for Berkshire grown during the 2010/11 season at the specified trial sites in WA ........................................................................................................... 9
List of Tables

Table 1 An example of the Ingo and variable costs for a triticale or wheat enterprise in a low rainfall area of Western Australia ................................................................. 10

Table 2 The gross margin (t/ha) for various yields and grain prices given the assumptions presented in Table 1. ................................................................. 11
1. Introduction

The CRC for an Internationally Competitive Pork Industry identified feed grains and pulses as a research priority (Program 1). In particular, research was directed towards breeding varieties of grains and pulses that could be grown in major pig production areas with the aim of securing more reliable and consistent energy (and protein) supplies for the formulation and manufacturing of pig diets. The expected outcomes of the research were a reduced variation in the annual cost of pig feed; a reduced total cost of pig feed; a wider range of feed ingredients available to more producers; and a closer match of diet specifications to pig requirements. To that end, a number of plant breeding projects were commissioned for the generation of new wheat, barley, triticale, and (or) pea varieties that contained favourable characteristics for the pig industry, such as a higher digestible energy (DE) content.

The overall aim of this report was to present data obtained from independent plant breeding trials to show the relative performance of Berkshire\(^1\) (triticale) in relation to a selection of grains currently available for commercial production. In particular, this report focuses on trial results from Western Australia.

2. Methodology

Across Australia and over a two-year time period, namely 2009/10 and 2010/11, InterGrain (IG) conducted research trials that were primarily designed to obtain information about new wheat and barley varieties. Berkshire was included in these trials so that the data collected could act as benchmark data and more generally to provide information for the Pork CRC triticale breeding project.

2.1. Trial Site Management

IG, a crop breeding company established as a joint venture between the Government of Western Australia, the Grains Research and Development Corporation (GRDC) and the Monsanto Company, were responsible for all aspects of management and reporting of results.

For the 2009/10 season, Berkshire along with commonly grown commercial wheat and barley varieties were incorporated into a field trial program. Two replicates were sown at each site. To improve agronomic management and increase the amount of data, the trial sites were established differently for the 2010/11 season so that barley and wheat were not necessarily located on the same sites.

2.2. Trial Site Locations

During the 2009/10 growing season and at the discretion of IG, Berkshire was allocated to six trial sites across the wheatbelt of WA (Figure 1).

\(^1\) Berkshire is protected by Plant Breeders Rights (PBR)
Figure 1 The pig producing areas of Australia (shaded) and the crop trial sites for the 2009/10 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005).

Key

(Note results from trial sites 7 to 20 are not relevant to this report but data concerning triticale at these sites is available from the report authors).

To fit with the overall IG crop breeding program, in the following season the trial locations were slightly different although the broad geographic regions were the same. There were 19 trial sites in WA (Figure 2).
Figure 2 The pig producing areas of Australia (shaded) and the trial sites for the 2010/11 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005).

Key
WA: 1. Northampton; Eradu; 2. Buntine; Arrino; 3. Dandaragan; Wongan Hills; Kalannie; 4. Meckering; Bullaring; Wilgoyne; Merredin; 5. Williams; Wagin 6. Mount Barker; Frankland; 7. Kukerin; Varley; 8. Coomalbidgup; Wittenoom Hills

(Note results from trial sites 7 to 20 are not relevant to this report but data concerning triticale at these sites is available from the report authors).

2.3. DE Data

AusScan calibrations were used to estimate starch, protein, fat and fibre components, and the DE content of the grains. Samples from the Western Australia sites were sent to the Department of Agriculture and Food, Grain Products Laboratory.

3. Outcomes

3.1. The 2009/10 Season

In the southern grains-belt of WA, conditions over winter were highly variable with crops in many areas showing signs of moisture stress (ABARE 2009). However, according to DAFWA (2009a), average to slightly above average rainfall over much of the WA wheatbelt in
September generally increased the crop yield rankings. Further, frost events during September were not widespread (DAFWA 2009a). Yields were average to above average ranging from 2 to 3 t/ha in western areas of the Northern Agricultural Region (DAFWA 2009b). However, protein in wheat was variable and the late rainfall resulted in a slight reduction in grain quality with sprouting damage reported in the Dandaragan area (DAFWA 2009b). Barley yields were generally poor, with more than half making feed grade due to low protein and screenings (DAFWA 2009b). In the central Agricultural region (incorporating Ballaring, Bullaring and Meckering), showers and thunderstorm activity in November resulted in above average rainfall for the region but caused crop losses. Barley screenings were high across most of the region. Small seed resulted in many growers missing Malt Grade 1. The Southern Agricultural Region (incorporating Darkan and Katanning) experienced erratic temperatures with hot days and associated thunderstorms, followed by wet, cool conditions resulting in average to slightly above average rainfall across the region. High screenings and low weights in barley were reported. These, and the other quality issues, were a result of the delayed start to the season, compounded by the prevailing dry and unstable conditions during November and December (DAFWA 2009b).

Due in part to a dry spring in WA, trial site yields were mostly below average. Frosts, particularly at Darkan and Katanning, also caused problems at trial sites. In WA the difference in yields between sites were large, e.g. at Dandaragan, Berkshire yielded 4.64 t/ha, whilst at Darkan it yielded 2.31 t/ha and at Wagin, 2.23 t/ha (Figure 3). Even so, at these latter sites, Berkshire out-yielded all of the wheat and barley varieties except for Flagship at Wagin.

![Yields of Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA.](image)

**Figure 3** Yields of Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA.

Whilst it was fairly competitive with wheat and barley varieties at Bullaring and Meckering, Berkshire generally yielded less than other varieties trialled at Dandaragan (Figure 4).
Even so the mean yield for Berkshire across all trial sites was similar to the other trial varieties with Berkshire having the smallest standard deviation (Figure 5).

Overall, Berkshire performed well against the trial wheat and barley varieties with Mace and Magenta having slightly higher average yields but a higher standard deviation than that of Berkshire. In terms of location, for the 2009/10 season, Berkshire performed well at Wagin and Darkan.

In view of faecal DE, the average value across the designated trial sites for Berkshire was up to 0.5 MJ/kg greater than any of the barley varieties but, as expected, around 3% less than that for wheat (Figure 6).
For the 2009/10 season, there was variance in DE for wheat, barley and triticale across all sites (Figure 6). For Berkshire the range in DE was from 13.43 MJ/kg at Dandaragan to 13.95 MJ/kg at Meckering (Figure 7).

**Figure 6** Average DE (MJ/kg) for Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in WA.

**Figure 7** DE (MJ/kg) for Berkshire grown during the 2009/10 season at the specified trial sites in WA.
3.2. The 2010/11 Season

In WA, below average autumn rainfall following a dry summer resulted in winter crop prospects being less positive (To et al., 2010a). To et al. (2010b) reported that after a dry autumn and start to winter, parts of the Geraldton region received above average rainfall in August with below average rainfall in spring. In the central wheatbelt, rainfall was mostly below average throughout the growing season and rainfall in the Albany zone was generally average in the coastal areas but below average further inland. The Esperance zone had above average rainfall in May, followed by average to below average monthly rainfall until November.

In general, it was very dry in WA, with some project sites not harvested because of this e.g. Varley. In WA six project sites were classified as good to excellent. Yield was compromised at four sites due to adverse climatic conditions and five sites were not harvested because of the drought. Berkshire was expected to out-yield wheat and barley at some sites as it has more resistance to dry conditions.

The results indicated that in terms of yield, Berkshire was competitive with the selected wheat varieties at the various trial site (Figure 8).

![Yields of Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in WA.](image_url)

This finding was particularly pertinent for the trial sites at Meckering, Coomalbidgup and Northamton (Figure 9).
Figure 9 Yields as a percentage of Berkshire for various wheat varieties grown during the 2010/11 season at the specified trial sites in WA.

However, when yields were considered across all trial sites, the average yield for Berkshire was in line with Mace, Magenta, Wyalkatchem and EGA Bonnie Rock (Figure 10).

Figure 10 Average yields (t/ha) for Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in WA.

In terms of average DE, the value for Berkshire was lower than all of the specified wheat varieties by 2% or less (Figure 11).
Figure 11 Average DE (MJ/kg) for Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in WA.

Whilst the variation in DE for Berkshire grown at different sites during the 2010/11 season was not as great as for the previous season there was still a range of 0.25 MJ/kg (Figure 12). There was also a difference between seasons. For example, the DE of Berkshire grown at the Dandaragan site was 13.43 MJ/kg in 2009/10 (Figure 7) and 13.73 MJ/kg for the 2010/11 season.

Figure 12 DE (MJ/kg) for Berkshire grown during the 2010/11 season at the specified trial sites in WA.
3.3. An Example Gross Margin Analysis

Gross margin analyses can be useful when contemplating which enterprise would be best suited to a particular area of land. Care must be taken to ensure that comparisons are valid in terms of the costs and revenue streams that are included in the analyses. The following analysis focuses on a low rainfall scenario where the variable costs for planting wheat and triticale are assumed to be the same (Table 1).

Table 1 An example of the Ingo and variable costs for a triticale or wheat enterprise in a low rainfall area of Western Australia

<table>
<thead>
<tr>
<th>Ingo</th>
<th>180.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross grain price ($/t: cash equivalent)</td>
<td>180.00</td>
</tr>
<tr>
<td>Freight ($/t: paddock to port)</td>
<td>25.40</td>
</tr>
<tr>
<td>Other deductions ($/t)</td>
<td>7.20</td>
</tr>
<tr>
<td>Net price on-farm ($/t)</td>
<td>147.40</td>
</tr>
<tr>
<td>Grain yield (t/ha)</td>
<td>2.50</td>
</tr>
<tr>
<td><strong>Total Ingo ($/ha)</strong></td>
<td>368.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable costs ($/ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>13.63</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>29.94</td>
</tr>
<tr>
<td>Spray</td>
<td>45.39</td>
</tr>
<tr>
<td>Fuel and oil</td>
<td>16.00</td>
</tr>
<tr>
<td>Repairs and maintenance</td>
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<tr>
<td>Variable Depreciation</td>
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<tr>
<td>Harvest contractors</td>
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</tr>
<tr>
<td>Labour</td>
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</tr>
<tr>
<td>Insurance</td>
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</tr>
<tr>
<td>Finance</td>
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</tr>
<tr>
<td><strong>Total variable costs ($/ha)</strong></td>
<td>145.25</td>
</tr>
</tbody>
</table>

| Gross Margin ($/ha)              | 223.25 |

Assuming the parameters outlined in Table 1, the gross margin (t/ha) for various yields and grain prices can be calculated (Table 2). Based on the trial results presented in the sections above, yield did not fall below 1 t/ha despite adverse conditions at some trial sites. Hence with a gross grain price greater than $170/ha, for this example, the gross margin would be positive. Assuming a gross price for triticale of $180/t² and a yield of around 1.50 t/ha (e.g. Kalannie, Figure 8 above) the expected gross margin would be around $82/ha. As suggested in Figures 5 and 10, the yield of Berkshire was competitive with that of wheat. Whilst data from Dairy Australia (2012) indicates that the price of triticale has at times tracked that of wheat, most often in Western Australia, wheat prices are greater than triticale prices. So even though in this case the gross margin for Berkshire may be slightly lower than that for wheat, the agronomic benefits may compensate for this difference. Moreover, given for example the 2009/10 season in Darkan and Wagin, and the 2010/11 season in Meckering, where wheat yields were around

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² Based on historical data provided by Dairy Australia (2012), $180/t is a relatively low price for triticale.
10 to 40% lower than those of Berkshire, the gross margin for Berkshire would indicate that it was a favourable alternative to wheat.

Table 2 The gross margin (t/ha) for various yields and grain prices given the assumptions presented in Table 1.

<table>
<thead>
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<th>Grain yield (t/ha)</th>
<th>Gross grain price ($/t: cash equivalent)</th>
<th>170</th>
<th>180</th>
<th>190</th>
<th>200</th>
<th>210</th>
<th>220</th>
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</tbody>
</table>

4. Application of Research

This project indicated that it is possible for Berkshire to yield well when compared with common wheat and barley varieties. Whilst trial sites were not specifically allocated to acidic soils, it is possible that Berkshire could out-perform alternative crops on such soils. Hence grain producers may consider it as a break crop or as an option for acidic soils.

In terms of DE of Berkshire, it would appear that there are differences between seasons and sites. Further, unreleased data on 11 triticale varieties (not including Berkshire) grown in one trial year in WA, by a private plant breeding company, varied from 13.2 to 13.8 MJ/kg. Given the variation that can occur between sites and seasons, it is difficult to draw any conclusions based on these figures except that there is variation in digestible energy and six of the 11 varieties had a DE value greater than 13.5 MJ/kg (so perhaps in line with Berkshire). Hence, it may be to their advantage for feed manufacturers and end users to consider these differences when evaluating and buying grain.

5. Conclusion

It is good practice not to judge the performance of a variety from only one or two years of data. For example, for the 2010/11 season, at the Meckering trial site the yield for Mace was 88% of that for Berkshire whereas for the 2009/10 season it was 114% of the Berkshire yield.
However, the yield (with relatively low variance) for Berkshire across sites for each year was competitive with that of the wheat varieties.

A simple gross margin analysis was presented to provide an indication of how Berkshire compares to wheat. In locations and seasons where Berkshire outperforms wheat by for example 20%, it is possible (contingent upon prices) that it will produce a greater return than wheat. Further, the agronomic benefits from growing Berkshire may result in it being an attractive alternative for grain growers.

The finding that there was a range in DE of 0.5 MJ/kg for the 2009/10 season and 0.25 MJ/kg for the 2010/11 season for Berkshire grown at different sites may be significant for pig feed manufacturers. Further, a variation of 0.3 MJ/kg for Berkshire grown at one site over two seasons may add to this significance.

Whilst outside the scope of this project, it would have been useful to have data regarding soil type to help explain some of the findings. In addition, information related to agronomic advantages of growing Berkshire as a break crop would also be useful for grain producers.

6. References


PORK CRC PROJECT 4B - 115: ADVANCING BERKSHIRE TRITICALE SUPPLY FOR THE AUSTRALIAN PIG INDUSTRY

Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

APPENDIX 3: BERKSHIRE TRITICALE IN SOUTH AUSTRALIA

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January 2013

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Executive Summary

The CRC for an Internationally Competitive Pork Industry identified feed grains and pulses as a research priority (Program 1). In particular, research was directed towards breeding varieties of grains and pulses that could be grown in major pig production areas with the aim of securing more reliable and consistent energy (and protein) supplies for the formulation and manufacturing of pig diets. The expected outcomes of the research were a reduced variation in the annual cost of pig feed; a reduced total cost of pig feed; a wider range of feed ingredients available to more producers; and a closer match of diet specifications to pig requirements. To that end, a number of plant breeding projects were commissioned for the generation of new wheat, barley, triticale, and (or) pea varieties that contained favourable characteristics for the pig industry, such as a higher digestible energy (DE) content.

The overall aim of this report was to present data obtained from independent plant breeding trials to show the relative performance of Berkshire (triticale), a PBR variety, in relation to a selection of grains currently available for commercial production. This report focuses on trial results from South Australia, and in this regard, we submit that judging the performance of a variety of grain from only one or two years of data should be viewed with some caution.

For example, for the 2009/10 season, at the Cummins trial site the yield for Wyalkatchem was 68% of that for Berkshire whereas for the 2010/11 season it was 101% of the Berkshire yield. However, the yield (with relatively low variance) for Berkshire across sites for each year was competitive with that of the wheat varieties.

A simple gross margin analysis was presented to provide an indication of how Berkshire compares to wheat. In locations and seasons where Berkshire outperforms wheat by for example 20%, it is possible (contingent upon prices) that it will produce a greater return than wheat. Further, the agronomic benefits from growing Berkshire may result in it being an attractive alternative for grain growers.

The finding that there was a range in DE of 0.1 MJ/kg for the 2009/10 season for Berkshire grown at different sites may be significant for pig feed manufacturers. Of further consideration, results in Western Australia indicated a greater range in DE of 0.5 MJ/kg for the 2009/10 season and 0.25 MJ/kg for the 2010/11 season for Berkshire grown at different sites. Hence it may be to their advantage for feed manufacturers and end users to consider DE when evaluating and buying grain.

Whilst outside the scope of this project, it would have been useful to have data regarding soil type to help explain some of the findings. In addition, information related to agronomic advantages of growing Berkshire as a break crop would also be useful for grain growers.

This report indicated that it is possible for Berkshire to yield well when compared with conventional wheat and barley varieties grown in South Australia. Whilst trial sites were not specifically allocated to alkaline soils, it is possible that Berkshire could out-perform alternative crops on such soils. Hence grain producers may consider it as a break crop or as an option for alkaline soils.
Table of Contents

Executive Summary ............................................................................................................................................. i
List of Figures .................................................................................................................................................. iii
List of Tables ................................................................................................................................................... iv
1. Introduction ................................................................................................................................................ 1
2. Methodology ............................................................................................................................................... 1
2.1. Trial Site Management ....................................................................................................................... 1
2.2. Trial Site Locations ............................................................................................................................. 1
2.3. DE Data ................................................................................................................................................... 3
3. Outcomes .................................................................................................................................................... 3
3.1. The 2009/10 Season ............................................................................................................................ 3
3.2. The 2010/11 Season ............................................................................................................................ 7
3.3. An Example Gross Margin Analysis .................................................................................................... 9
4. Application of Research .............................................................................................................................. 10
5. Conclusion ................................................................................................................................................. 10
6. References ................................................................................................................................................ 11
List of Figures

Figure 1 The pig producing areas of Australia (shaded) and the crop trial sites for the 2009/10 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005). .................................................. 2

Figure 2 The pig producing areas of Australia (shaded) and the trial sites for the 2010/11 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005). .................................................... 3

Figure 3 Yields of Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA. ...................................................................................................................... 4

Figure 4 Yields as a percentage of Berkshire for various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA. .................................................................................................................. 5

Figure 5 Average yields (t/ha) for Berkshire triticale and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA. ................................................................. 5

Figure 6 Average DE (MJ/kg) for Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA. .......................................................................................... 6

Figure 7 DE (MJ/kg) for Berkshire grown during the 2009/10 season at the specified trial sites in SA. ...... 6

Figure 8 Yields of Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in SA. .................................................................................................................. 7

Figure 9 Yields as a percentage of Berkshire for various wheat varieties grown during the 2010/11 season at the specified trial sites in SA. .......................................................................................................... 8

Figure 10 Average yields (t/ha) for Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in SA. ....................................................................................................... 8
List of Tables

Table 1 An example of the Ingo and variable costs for a triticale or wheat enterprise in a low rainfall area of South Australia ........................................................................................................................................ 9

Table 2 The gross margin (t/ha) for various yields and grain prices given the assumptions presented in Table 1. ....................................................................................................................................................... 10
1. Introduction

The CRC for an Internationally Competitive Pork Industry identified feed grains and pulses as a research priority (Program 1). In particular, research was directed towards breeding varieties of grains and pulses that could be grown in major pig production areas with the aim of securing more reliable and consistent energy (and protein) supplies for the formulation and manufacturing of pig diets. The expected outcomes of the research were a reduced variation in the annual cost of pig feed; a reduced total cost of pig feed; a wider range of feed ingredients available to more producers; and a closer match of diet specifications to pig requirements. To that end, a number of plant breeding projects were commissioned for the generation of new wheat, barley, triticale, and (or) pea varieties that contained favourable characteristics for the pig industry, such as a higher digestible energy (DE) content.

The overall aim of this report was to present data obtained from independent plant breeding trials to show the relative performance of Berkshire\(^1\) (triticale) in relation to a selection of grains currently available for commercial production. In particular, this report focuses on trial results from South Australia.

2. Methodology

Across Australia and over a two-year time period, namely 2009/10 and 2010/11, InterGrain (IG) conducted research trials that were primarily designed to obtain information about new wheat and barley varieties. Berkshire was included in these trials so that the data collected could act as benchmark data and more generally to provide information for the Pork CRC triticale breeding project.

2.1. Trial Site Management

IG, a crop breeding company established as a joint venture between the Government of Western Australia, the Grains Research and Development Corporation (GRDC) and the Monsanto Company, were responsible for all aspects of management and reporting of results.

For the 2009/10 season, Berkshire along with commonly grown commercial wheat and barley varieties were incorporated into a field trial program. Two replicates were sown at each site. To improve agronomic management and increase the amount of data, the trial sites were established differently for the 2010/11 season so that barley and wheat were not necessarily located on the same sites.

2.2. Trial Site Locations

During the 2009/10 growing season and at the discretion of IG, Berkshire was allocated to four trial sites across the wheatbelt of SA (Figure 1).

\(^1\) Berkshire is protected by Plant Breeders Rights (PBR)
Figure 1 The pig producing areas of Australia (shaded) and the crop trial sites for the 2009/10 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005).

Key

(Note results from trial sites 1 to 5 and 11 to 20 are not relevant to this report but data concerning triticale at these sites is available from the report authors).

To fit with the overall IG crop breeding program, in the following season the trial locations were slightly different although the broad geographic regions were the same. There were nine trial sites in SA (Figure 2).
The pig producing areas of Australia (shaded) and the trial sites for the 2010/11 season (map from Geoscience Australia, 2005; shaded area based on APL, 2005).

Key
SA: 9. Cummins; Rudall; Lock; 10. Spalding; Paskeville; Urania; Balaklava; 11. Geranium; Wunkar

(Note results from trial sites 1 to 8 and 12 to 20 are not relevant to this report but data concerning triticale at these sites is available from the report authors).

2.3. DE Data

AusScan calibrations were used to estimate starch, protein, fat and fibre components, and the DE content of the grains. Samples from the South Australian sites were sent to the NSW Department of Primary Industries, Wagga Wagga Agriculture Institute laboratory for testing.

3. Outcomes

3.1. The 2009/10 Season

ABARE (2009) reported that despite below average August rainfall, winter crops in SA were in a good position leading into spring and warmer temperatures had assisted crop growth. For the Lower Eyre Peninsula (incorporating Cummins) spring conditions were ideal for grain fill with warm northerlies, average rainfall and no serious disease or pest issues (Rural Solutions...
Rainfall was variable with average to above average falls recorded, although hail caused crop losses of up to 90% in some parts. Yield and quality of barley was variable. Balaklava in the Mid North region experienced mild conditions with above average rainfall recorded during late September. In the western part of the district, grain was of good quality. The Yorke Peninsula, incorporating Paskeville in the north, recorded several warm to hot days in the first half of September followed by cool to mild conditions, with warm to hot weather returning later in October. There were a few isolated, light frosts during September and early October with thunderstorm activity in September bringing gale force winds and scattered hail showers. Nevertheless, yields for early barley crops ranged from 2 to 5 t/ha (Rural Solutions SA 2009).

In SA there was variation in yields between sites with, e.g. Berkshire yielding 4.37 t/ha at Cummins and 2.60 t/ha at Rudall (Figure 3). Moreover, Berkshire was competitive with the wheat and barley trialled at each of the sites.

**Figure 3** Yields of Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA.

For wheat, this was particularly the case at Cummins, Balaklava and Paskeville, whilst Berkshire out-yielded all barley varieties, except for Lockyer, at Rudall (Figure 4).
Yields as a percentage of Berkshire for various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA. Further, the average yield for Berkshire across all trial sites was similar to or better than the other trial varieties with the exception being Lockyer barley (Figure 5).

Overall, Berkshire performed well against the trial wheat and barley varieties with Magenta having only slightly higher average yields and Lockyer yielding on average 0.7 t/ha better than Berkshire. In terms of location, for the 2009/10 season, Berkshire performed well at each of the trial sites.

In view of faecal DE, the average value across the designated trial sites for Berkshire was up to 0.5 MJ/kg greater than some of the barley varieties but, as expected, around 5% less than that for wheat (Figure 6).
For the 2009/10 season, there was a relatively small variance in DE for wheat, barley and triticale across all sites (Figure 6). This was also the case for Berkshire with the range in DE being from 13.31 MJ/kg at Paskeville to 13.41 MJ/kg at Rudall (Figure 7).

**Figure 6** Average DE (MJ/kg) for Berkshire and various wheat and barley varieties grown during the 2009/10 season at the specified trial sites in SA.

**Figure 7** DE (MJ/kg) for Berkshire grown during the 2009/10 season at the specified trial sites in SA.
3.2. The 2010/11 Season

Autumn rainfall was average to above average across the majority of SA’s cropping regions, with timely rainfall in late May helping to replenish subsoil moisture profiles (To et al., 2010a). Rainfall in July was below average in most of the SA cropping areas, while August rainfall was mostly above average and there was good follow up rainfall in early September (To et al. 2010b). Average rainfall results were recorded for October (To et al. 2010c).

All nine project sites in SA were deemed good to excellent. Wheat yields were expected to average 2.5 t/ha (although protein levels were expected to be down) and average barley yields were forecast to be a record 2.6 t/ha, double the five-year average of 1.64 t/ha (To et al. 2010c).

The results indicated that in terms of yield, Berkshire was competitive with the selected wheat varieties at the various trial sites. Further, the yield for Berkshire ranged from 6.61 t/ha at Jamestown to 3.43 t/ha at Loxton (Figure 8).

![Figure 8 Yields of Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in SA.](image)

This finding was particularly pertinent for the trial sites at Cummins, Jamestown, Urania and Geranium (Figure 9).
Yields as a percentage of Berkshire for various wheat varieties grown during the 2010/11 season at the specified trial sites in SA.

However, when yields were considered across all trial sites, the average yield for Berkshire was slightly better than that other varieties considered in the trial (Figure 10).

Average yields (t/ha) for Berkshire and various wheat varieties grown during the 2010/11 season at the specified trial sites in SA.

DE for Berkshire grown at different sites during the 2010/11 season was not analysed in this experiment and hence the data is not available.
3.3. An Example Gross Margin Analysis

Gross margin analyses can be useful when contemplating which enterprise would be best suited to a particular area of land. Care must be taken to ensure that comparisons are valid in terms of the costs and revenue streams that are included in the analyses. The following analysis focuses on a low rainfall scenario where the variable costs for planting wheat and triticale are assumed to be the same (Table 1).

Table 1 An example of the Ingo and variable costs for a triticale or wheat enterprise in a low rainfall area of South Australia

<table>
<thead>
<tr>
<th>Ingo</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross grain price ($/t: cash equivalent)</td>
<td>180.00</td>
</tr>
<tr>
<td>Freight ($/t: paddock to port)</td>
<td>25.40</td>
</tr>
<tr>
<td>Other deductions ($/t)</td>
<td>7.20</td>
</tr>
<tr>
<td>Net price on-farm ($/t)</td>
<td>147.40</td>
</tr>
<tr>
<td>Grain yield (t/ha)</td>
<td>2.50</td>
</tr>
<tr>
<td><strong>Total Ingo ($/ha)</strong></td>
<td>368.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable costs ($/ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>13.63</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>29.94</td>
</tr>
<tr>
<td>Spray</td>
<td>45.39</td>
</tr>
<tr>
<td>Fuel and oil</td>
<td>16.00</td>
</tr>
<tr>
<td>Repairs and maintenance</td>
<td>13.00</td>
</tr>
<tr>
<td>Variable Depreciation</td>
<td>0.00</td>
</tr>
<tr>
<td>Harvest contractors</td>
<td>11.00</td>
</tr>
<tr>
<td>Labour</td>
<td>12.60</td>
</tr>
<tr>
<td>Insurance</td>
<td>3.69</td>
</tr>
<tr>
<td>Finance</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total variable costs ($/ha)</strong></td>
<td>145.25</td>
</tr>
</tbody>
</table>

| Gross Margin ($/ha) | 223.25 |

Assuming the parameters outlined in Table 1, the gross margin (t/ha) for various yields and grain prices can be calculated (Table 2). Based on the trial results presented in the sections above, yield did not fall below 2.5 t/ha. Hence with a gross grain price greater than $90/ha, for this example, the gross margin would be positive. Assuming a gross price for triticale of $180/t and a yield of around 2.50 t/ha (e.g. Rudall, Figure 4 above) the expected gross margin would be around $223/ha. As suggested in Figures 5 and 10, the yield of Berkshire was competitive with that of wheat. Whilst data from Dairy Australia (2012) indicates that the price of triticale has at times tracked that of wheat, most often in South Australia, wheat prices are greater than triticale prices. So even though in this case the gross margin for Berkshire may be slightly lower than that for wheat, the agronomic benefits may compensate for this difference. Moreover, given for example the 2009/10 season in Balaclava and Paskeville and the 2010/11 season in Jamestown, Urania and Geranium where wheat yields were around up to 20% lower

---

2 Based on historical data provided by Dairy Australia (2012), $180/t is a relatively low price for triticale.
than those of Berkshire, the gross margin for Berkshire would indicate that it was a favourable alternative to wheat.

**Table 2** The gross margin (t/ha) for various yields and grain prices given the assumptions presented in Table 1.

<table>
<thead>
<tr>
<th>Grain yield (t/ha)</th>
<th>90</th>
<th>180</th>
<th>190</th>
<th>200</th>
<th>210</th>
<th>220</th>
<th>230</th>
<th>240</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50</td>
<td>-52</td>
<td>82</td>
<td>96</td>
<td>111</td>
<td>126</td>
<td>141</td>
<td>156</td>
<td>171</td>
<td>185</td>
</tr>
<tr>
<td>1.75</td>
<td>-38</td>
<td>118</td>
<td>135</td>
<td>152</td>
<td>169</td>
<td>187</td>
<td>204</td>
<td>221</td>
<td>239</td>
</tr>
<tr>
<td>2.00</td>
<td>-25</td>
<td>153</td>
<td>173</td>
<td>193</td>
<td>212</td>
<td>232</td>
<td>252</td>
<td>272</td>
<td>291</td>
</tr>
<tr>
<td>2.25</td>
<td>-12</td>
<td>188</td>
<td>211</td>
<td>233</td>
<td>255</td>
<td>277</td>
<td>299</td>
<td>322</td>
<td>344</td>
</tr>
<tr>
<td>2.50</td>
<td>1</td>
<td>223</td>
<td>248</td>
<td>273</td>
<td>297</td>
<td>322</td>
<td>347</td>
<td>371</td>
<td>396</td>
</tr>
<tr>
<td>2.75</td>
<td>13</td>
<td>258</td>
<td>285</td>
<td>312</td>
<td>339</td>
<td>366</td>
<td>394</td>
<td>421</td>
<td>448</td>
</tr>
<tr>
<td>3.00</td>
<td>25</td>
<td>292</td>
<td>322</td>
<td>351</td>
<td>381</td>
<td>410</td>
<td>440</td>
<td>470</td>
<td>499</td>
</tr>
<tr>
<td>3.25</td>
<td>37</td>
<td>326</td>
<td>358</td>
<td>390</td>
<td>422</td>
<td>454</td>
<td>486</td>
<td>518</td>
<td>550</td>
</tr>
<tr>
<td>3.50</td>
<td>48</td>
<td>359</td>
<td>394</td>
<td>428</td>
<td>463</td>
<td>497</td>
<td>532</td>
<td>566</td>
<td>601</td>
</tr>
<tr>
<td>3.75</td>
<td>59</td>
<td>392</td>
<td>429</td>
<td>466</td>
<td>503</td>
<td>540</td>
<td>577</td>
<td>614</td>
<td>651</td>
</tr>
<tr>
<td>4.00</td>
<td>70</td>
<td>425</td>
<td>464</td>
<td>504</td>
<td>543</td>
<td>583</td>
<td>622</td>
<td>662</td>
<td>701</td>
</tr>
<tr>
<td>4.25</td>
<td>80</td>
<td>457</td>
<td>499</td>
<td>541</td>
<td>583</td>
<td>625</td>
<td>667</td>
<td>709</td>
<td>751</td>
</tr>
<tr>
<td>4.50</td>
<td>90</td>
<td>489</td>
<td>534</td>
<td>578</td>
<td>622</td>
<td>667</td>
<td>711</td>
<td>756</td>
<td>800</td>
</tr>
</tbody>
</table>

4. **Application of Research**

This project indicated that it is possible for Berkshire to yield well when compared with common wheat and barley varieties. Whilst trial sites were not specifically allocated to alkaline soils, it is possible that Berkshire could out-perform alternative crops on such soils. Hence grain producers may consider it as a break crop or as an option for alkaline soils.

In terms of DE of Berkshire, it would appear that there are differences between varieties and sites. Hence it may be to their advantage for feed manufacturers and end users to consider these differences when evaluating and buying grain.

5. **Conclusion**

It is good practice not to judge the performance of a variety from only one or two years of data. For example, for the 2009/10 season, at the Cummins trial site the yield for Wyalkatchem was 68% of that for Berkshire whereas for the 2010/11 season it was 101% of the Berkshire yield. However, the yield (with relatively low variance) for Berkshire across sites for each year was competitive with that of the wheat varieties.

A simple gross margin analysis was presented to provide an indication of how Berkshire compares to wheat. In locations and seasons where Berkshire outperforms wheat by for example 20%, it is possible (contingent upon prices) that it will produce a greater return than wheat. Further, the agronomic benefits from growing Berkshire may result in it being an attractive alternative for grain growers.
The finding that there was a range in DE of 0.1 MJ/kg for the 2009/10 season for Berkshire grown at different sites may be significant for pig feed manufacturers. Of further consideration, results in Western Australia indicated a greater range in DE of 0.5 MJ/kg for the 2009/10 season and 0.25 MJ/kg for the 2010/11 season for Berkshire grown at different sites (See Pluske and Pluske 2012).

Whilst outside the scope of this project, it would have been useful to have data regarding soil type to help explain some of the findings. In addition, information related to agronomic advantages of growing Berkshire as a break crop would also be useful for grain producers.

6. References


Appendix 4: Nutritional Profile of Berkshire

Final Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

By

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SciEcons Consulting
Subiaco WA 6904
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Professor John Pluske
Murdoch University
Murdoch WA 6150
AUSTRALIA

June 2014
A Nutritional Profile of Berkshire (Triticale)

Table 1. AusScan NIR results for the triticale cv. Berkshire

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Bottom 10%</th>
<th>Bottom 25%</th>
<th>Median</th>
<th>Top 25%</th>
<th>Top 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIG Faecal DE (MJ/kg as fed)</td>
<td>&lt;12.70</td>
<td>&lt;13.20</td>
<td>13.46</td>
<td>&gt;13.80</td>
<td>&gt;14.00</td>
</tr>
<tr>
<td>PIG ileal DE (MJ/kg as fed)</td>
<td>&lt;9.40</td>
<td>&lt;10.90</td>
<td>11.45</td>
<td>&gt;12.10</td>
<td>&gt;12.70</td>
</tr>
<tr>
<td>Total Insoluble NSP (% DM)</td>
<td>&lt;8.20</td>
<td>&lt;9.50</td>
<td>10.98</td>
<td>&gt;11.50</td>
<td>&gt;13.00</td>
</tr>
<tr>
<td>Total Soluble NSP (% DM)</td>
<td>&lt;1.30</td>
<td>&lt;1.60</td>
<td>1.85</td>
<td>&gt;2.00</td>
<td>&gt;2.80</td>
</tr>
<tr>
<td>Insoluble Arabinoxylans (% DM)</td>
<td>&lt;5.10</td>
<td>&lt;6.10</td>
<td>7.08</td>
<td>&gt;7.40</td>
<td>&gt;8.00</td>
</tr>
<tr>
<td>β-glucans (% DM)</td>
<td>&lt;0.35</td>
<td>&lt;0.62</td>
<td>0.66</td>
<td>&gt;0.72</td>
<td>&gt;0.97</td>
</tr>
<tr>
<td>Hydration Capacity (%)</td>
<td>&lt;44.3</td>
<td>&lt;49.9</td>
<td>56.6</td>
<td>&gt;63.6</td>
<td>&gt;76.9</td>
</tr>
<tr>
<td>Crude Fibre (% DM)</td>
<td>&lt;2.7</td>
<td>&lt;3.1</td>
<td>3.2</td>
<td>&gt;3.4</td>
<td>&gt;4.0</td>
</tr>
<tr>
<td>Acid Detergent Fibre (% DM)</td>
<td>&lt;2.9</td>
<td>&lt;3.3</td>
<td>3.8</td>
<td>&gt;4.8</td>
<td>&gt;4.89</td>
</tr>
<tr>
<td>Englyst Neutral Detergent Fibre (% DM)</td>
<td>&lt;9.1</td>
<td>&lt;13.0</td>
<td>15.9</td>
<td>&gt;16.8</td>
<td>&gt;18.7</td>
</tr>
<tr>
<td>Total Starch (% DM)</td>
<td>&lt;60.0</td>
<td>&lt;62.1</td>
<td>63.3</td>
<td>&gt;66.0</td>
<td>&gt;67.5</td>
</tr>
</tbody>
</table>

Source: AUSSCAN® Calibration result interpretation (Version 3 October 2011)

Table 2. AusScan NIR results\(^1\) for five samples of Berkshire\(^2\)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIG Faecal DE (MJ/kg as fed)</td>
<td>13.71</td>
<td>13.87</td>
<td>14.18</td>
<td>0.173</td>
<td>13.90</td>
</tr>
<tr>
<td>PIG ileal DE (MJ/kg as fed)</td>
<td>12.16</td>
<td>12.37</td>
<td>14.25</td>
<td>0.875</td>
<td>12.72</td>
</tr>
<tr>
<td>Total Insoluble NSP (% DM)</td>
<td>6.60</td>
<td>7.01</td>
<td>8.75</td>
<td>0.877</td>
<td>7.46</td>
</tr>
<tr>
<td>Total Soluble NSP (% DM)</td>
<td>-0.59</td>
<td>0.54</td>
<td>0.87</td>
<td>0.576</td>
<td>0.36</td>
</tr>
<tr>
<td>Insoluble Arabinoxylans (% DM)</td>
<td>3.08</td>
<td>4.26</td>
<td>5.80</td>
<td>1.071</td>
<td>4.53</td>
</tr>
<tr>
<td>β-glucans (% DM)</td>
<td>-0.05</td>
<td>0.24</td>
<td>0.96</td>
<td>0.443</td>
<td>0.41</td>
</tr>
<tr>
<td>Hydration Capacity (%)</td>
<td>41.42</td>
<td>43.64</td>
<td>53.99</td>
<td>5.133</td>
<td>45.03</td>
</tr>
<tr>
<td>Crude Fibre (% DM)</td>
<td>2.43</td>
<td>2.87</td>
<td>3.44</td>
<td>0.394</td>
<td>2.83</td>
</tr>
<tr>
<td>Acid Detergent Fibre (% DM)</td>
<td>2.63</td>
<td>2.89</td>
<td>3.45</td>
<td>0.317</td>
<td>2.92</td>
</tr>
<tr>
<td>Englyst Neutral Detergent Fibre (% DM)</td>
<td>13.40</td>
<td>14.28</td>
<td>17.50</td>
<td>1.746</td>
<td>14.86</td>
</tr>
<tr>
<td>Total Starch (% DM)</td>
<td>63.86</td>
<td>69.08</td>
<td>72.37</td>
<td>3.641</td>
<td>67.77</td>
</tr>
</tbody>
</table>

Analyses completed 8\(^{th}\) April 2013 (DAFWA)

\(^1\)Only minimum, median and maximum results are provided due to the number of samples tested n=5

\(^2\)The five samples were harvested in the central medium rainfall region in WA during the 2012/13 season.
Table 3. Amino acid content (g/kg air-dry basis) of five samples of Berkshire

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Min</th>
<th>Median</th>
<th>Max</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>107.94</td>
<td>112.50</td>
<td>130.02</td>
<td>8.95</td>
<td>114.55</td>
</tr>
<tr>
<td>Aspartic acid</td>
<td>7.18</td>
<td>7.41</td>
<td>8.29</td>
<td>0.452</td>
<td>7.52</td>
</tr>
<tr>
<td>Glutamic acid</td>
<td>27.54</td>
<td>29.27</td>
<td>34.68</td>
<td>2.783</td>
<td>29.90</td>
</tr>
<tr>
<td>Serine</td>
<td>5.50</td>
<td>5.74</td>
<td>6.60</td>
<td>0.450</td>
<td>5.82</td>
</tr>
<tr>
<td>Histidine</td>
<td>2.49</td>
<td>2.80</td>
<td>2.92</td>
<td>0.174</td>
<td>2.75</td>
</tr>
<tr>
<td>Glycine</td>
<td>4.61</td>
<td>4.64</td>
<td>5.57</td>
<td>0.415</td>
<td>4.83</td>
</tr>
<tr>
<td>Threonine</td>
<td>3.94</td>
<td>4.02</td>
<td>4.54</td>
<td>0.240</td>
<td>4.14</td>
</tr>
<tr>
<td>Cysteine-X</td>
<td>2.80</td>
<td>2.96</td>
<td>3.29</td>
<td>0.206</td>
<td>2.99</td>
</tr>
<tr>
<td>Alanine</td>
<td>4.36</td>
<td>4.54</td>
<td>5.22</td>
<td>0.335</td>
<td>4.64</td>
</tr>
<tr>
<td>Arginine</td>
<td>5.53</td>
<td>5.78</td>
<td>6.42</td>
<td>0.377</td>
<td>5.88</td>
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<tr>
<td>Tyrosine</td>
<td>3.30</td>
<td>3.51</td>
<td>3.61</td>
<td>0.126</td>
<td>3.50</td>
</tr>
<tr>
<td>Valine</td>
<td>4.84</td>
<td>5.05</td>
<td>5.83</td>
<td>0.388</td>
<td>5.15</td>
</tr>
<tr>
<td>Methio-nine</td>
<td>1.97</td>
<td>2.05</td>
<td>2.28</td>
<td>0.126</td>
<td>2.11</td>
</tr>
<tr>
<td>Phenyl-alanine</td>
<td>5.00</td>
<td>5.20</td>
<td>6.14</td>
<td>0.469</td>
<td>5.34</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>3.73</td>
<td>3.86</td>
<td>4.56</td>
<td>0.343</td>
<td>3.98</td>
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<tr>
<td>Leucine</td>
<td>7.29</td>
<td>7.52</td>
<td>8.89</td>
<td>0.656</td>
<td>7.76</td>
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<tr>
<td>Lysine</td>
<td>3.36</td>
<td>3.42</td>
<td>4.45</td>
<td>0.461</td>
<td>3.64</td>
</tr>
<tr>
<td>Proline</td>
<td>13.39</td>
<td>14.01</td>
<td>16.84</td>
<td>1.347</td>
<td>14.60</td>
</tr>
</tbody>
</table>

Analyses completed 2nd April 2013 (Analyst: MMcGrath, DAFWA)

1The five samples were harvested in the central medium rainfall region in WA during the 2012/13 season

Table 4. Selected analyses of wheat samples (cv. Mace, Yitpe) and Berkshire obtained from a farm in south-western Australia in the 2013 growing season and conducted at two different laboratories (Symbio and DAFWA). The difference (Diff, %) is the percentage difference between the lowest and highest values for each sample for each analysis.

<table>
<thead>
<tr>
<th></th>
<th>Crude protein, % (as fed)</th>
<th>Diff, %</th>
<th>Faecal DE, MJ/kg (as fed)</th>
<th>Diff, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Symbio</td>
<td>DAFWA</td>
<td>Symbio</td>
<td>DAFWA</td>
</tr>
<tr>
<td>Mace (wheat 1):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mace (wheat 2):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yitpe (wheat)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berkshire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.9</td>
<td>9.18</td>
<td>7.8</td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>12.4</td>
<td>10.45</td>
<td>18.7</td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>12.0</td>
<td>10.94</td>
<td>9.7</td>
<td>14.1</td>
</tr>
<tr>
<td></td>
<td>10.9</td>
<td>9.46</td>
<td>15.2</td>
<td>13.6</td>
</tr>
</tbody>
</table>

Analyses completed January 2014
PROJECT 4B- 115: ADVANCING BERKSHIRE TRITICALE SUPPLY FOR THE AUSTRALIAN PIG INDUSTRY

Appendix 5: Notes for Berkshire value and tonnage

Final Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

By

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June 2014
Project 4B-115: Advancing Berkshire triticale supply for the Australian pig industry

Berkshire Value: A Note

Nutritionist, Daniel Goussac completed three feed formulation scenarios with the aim of estimating a ‘value’ for Berkshire. In one series of formulations, he used a single-mix (typical pig finisher feed, 13.2 MJ/kg) and in the second, he used a multi-mix (series of 7 different feeds). He found that there was no significant difference in Berkshire values generated for both mixes.

With a fixed price of barley at $330/t, for each wheat price, the corresponding highest value for Berkshire was estimated to be slightly lower, $3 to $5/t, than the price of wheat (Figure 1).

Figure 1. Given a moving wheat price and a fixed price of barley (●), the value of Berkshire (●) was estimated to be between $3 and $5/t lower than the corresponding wheat price.

Setting wheat to a fixed price of $360/t and varying the barley price resulted in the value of Berkshire being estimated at around $90/t higher than the corresponding barley price when at low levels with the difference falling to around $30/t when the price of barley rose to $290/t (Figure 2).
Given a fixed wheat price of $360/t and a moving barley price, the estimated value of Berkshire was between $30 and $90/t higher than the price for barley.

Given moving wheat and barley prices, estimated Berkshire values were estimated to be greater, by around $25/t, than the corresponding barley price but between $3 and $5/t lower than the corresponding wheat price (Figure 3).

Whilst it may be unlikely that barley or wheat prices would be fixed at such high levels, these analyses showed that the estimated value of Berkshire more closely tracks the wheat price than the barley price.

Project 4B-115: Advancing Berkshire triticale supply for the Australian pig industry

Berkshire Tonnage in WA: A Note

Known seed sales of Berkshire have taken place in Western Australia from 2009 to 2012 (Table 1). Sales of grain grown from this seed is subject to an End Point Royalty (EPR). However, most sales do not go through the grain receival system and generally it is not segregated at the point of sale. To date there has not been an official premium paid for Berkshire. Without expensive testing, it is also difficult to detect Berkshire from other triticale varieties. Hence, there is little incentive on the part of the grower to declare a triticale crop as Berkshire. Due to this obscure supply chain, the quantity of Berkshire in the supply chain ambiguous.

Table 1. The year of known seed sales of Berkshire in various areas in Western Australia.

<table>
<thead>
<tr>
<th>Area</th>
<th>Year of known seed sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popanyinning</td>
<td>2009</td>
</tr>
<tr>
<td>Cuballing</td>
<td>2009</td>
</tr>
<tr>
<td>Wannamal</td>
<td>2009</td>
</tr>
<tr>
<td>Capel</td>
<td>2009</td>
</tr>
<tr>
<td>Kalannie</td>
<td>2010</td>
</tr>
<tr>
<td>Perenjori</td>
<td>2010</td>
</tr>
<tr>
<td>Boyanup</td>
<td>2010</td>
</tr>
<tr>
<td>Kellerberrin</td>
<td>2011</td>
</tr>
<tr>
<td>Pingelly</td>
<td>2012</td>
</tr>
<tr>
<td>Hyden</td>
<td>2012</td>
</tr>
<tr>
<td>Koorda</td>
<td>2012</td>
</tr>
<tr>
<td>Dalwallinu</td>
<td>2012</td>
</tr>
</tbody>
</table>

In an attempt to gain an idea as to the possible tonnage of Berkshire in WA at the end of 2013, a model based on simple assumptions can be used to generate estimates (Figure 1). These assumption include 10t of Berkshire seed being sown at 100kg/ha at each of the 12 sites listed in Table 1 with the subsequent crop yielding an average of 1.5t/ha. The proportion of the crop retained for seed was assumed to be a value between 0.05 and 0.3 and constant across years and sites. The grain not retained as seed was assumed to be sold as feed.

If just 5% of the Berkshire crop was retained as seed it could be expected that there would be just over 1,000t of Berkshire feed available at the end of 2013 with enough seed to plant around 600 ha. Retaining 30% of the crop would result in around 45,000t of Berkshire being available as feed and seed for 195,000 ha (Figure 1). While such a scenario is physically possible, it is not likely. Perhaps more likely is the scenario whereby 15% of grain is kept for seed leaving around 8,500 t being available for feed. Even so this would mean that there would be enough seed for around 15,000 ha of Berkshire crop for the 2014/15 season.
Anecdotal evidence suggests that this level of Berkshire planting will not occur. Taking this same proportion but applying a dynamic multiplier so that seed retention is perhaps a little more realistic results in an alternative prediction for Berkshire availability (Figure 2).

Given a dynamic reduction in the proportion of seed retained each year being a more likely scenario and the seasonal and market conditions in WA being unconducive to the rapid expansion of Berkshire production, it might be expected that Berkshire feed availability could be somewhere between 3,000 and 5,000 t with seed available for 2,000 to 5,000 ha.

Whilst these models are speculative, they provide an insight into what the current situation regarding Berkshire in WA might be and the potential that could be reached with favourable conditions.
Advancing Berkshire triticale supply for the Australian pig industry: An assessment of the supply chain in SA

31st May 2014

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Pork CRC Project 4B - 115 Advancing Berkshire triticale supply for the Australian pig industry: An assessment of the supply chain in SA

Project background ..................2
Influencers of grain supply.........2
An introduction to supply chains ….3
Supply chain versus commodity thinking .....3
Why a supply chain? ............4
Components of a Berkshire supply chain ......4
A successful Berkshire supply chain. ........5
Selection criteria for a Berkshire supply chain – who fits?....5
Benefits of a Berkshire supply chain........7
Issues Identified by pork producers ........7
The supply chain models............7
  Average pricing model ....7
  Contract farming model....9

Establishing a contract in South Australia ....10

Triticale as a commodity in South Australia ....16

The role of triticale in South Australian farming systems …21

Barriers to uptake of triticale by South Australian growers....21

Enablers for the uptake of Berkshire triticale ......22

Conclusions and recommendations....23

References.....25

Appendix ......26
Project background

A key objective of the Pork CRC is securing more reliable and consistent energy (and protein) supplies for pig diets that will cause: (a) reduced variation in the annual cost of pig feed, (b) reduced total cost of pig feed, (c) a wider range of feed ingredients available to more producers, and (d) a closer match of diet specifications to pig requirements.

In line with this objective Berkshire triticale, a high yielding grain-only triticale purpose-bred for feed qualities suited to the pork industry was developed.

This project, run in parallel to a similar program in Western Australia, aimed to develop, promote and establish a supply chain arrangement, from cereal growers through to piggery end-users to support the development of a specialist triticale industry in South Australia based on the Berkshire triticale variety.

Influencers of grain supply

There are a number of “big picture” factors that influence the availability and price of feed grain available to pork producers. Risks to grain supply include the following:

Global influences

With increasing focus on global supply chains and long term population growth there is increasing concern regarding the ability of the world to sustainably feed itself. Changes to diet trends in Asia and China and significant population growth in these regions has resulted in more meat protein, particularly chicken, being consumed.

As a consequence there is increasing intensive animal production for food purposes, with a resultant influences on traditional feed grain consumption patterns. This will place ongoing pressure on feed grain and protein meal supplies.

Security of supply

Ensuring secure long term supply is particularly important for many consumers. A recent example (March, 2014) is the instability between Russia and the Ukraine. This has resulted in a rally in global coarse grains, in response to uncertainty of supply from the Black Sea region.

Supply

Over the last ten years the ability to fund and hold strategic grain stocks has diminished. The market is accustomed to “just in time delivery”. No one sovereign country or grain trader has the financial desire to hold commodity stock. As a consequence, with reduced stock supply shocks are more prevalent. At some point consumers will increasingly become concerned with supply.

Quality

With increased focus on food and health there is significant pressure to increase accountability within the supply chain. Contamination scares like the 2013 Fonterra botulism milk powder safety recall provides a stark example. The focus, particularly from more affluent markets, quickly shifts to quality of supply. Feed grains are one step behind those directly for human consumption. Supply of feed that contains a contaminant which is then detected in livestock creates significant legal and market risk.
**Timeliness**

“Just in time” delivery, with reduced stocks, means that shorter delivery timelines will remain a focus. Provision of delivery just in time is what the supply chain is demanding.

**Volatility**

Global commodity prices will continue to trade the next weather forecast or change in government policy. As a result, volatility in grain prices is likely to continue.

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**An introduction to Supply Chains**

A supply chain is defined as the movement of materials as they flow from their source to the end customer. Supply Chain includes purchasing, manufacturing, warehousing, transportation, customer service, demand planning, supply planning and Supply Chain management. It is made up of the people, activities, information and resources involved in moving a product from its supplier to customer.

**Supply chain versus commodity thinking**

A commodity is a raw material or primary agricultural product that can be bought and sold. Commodities are most often used as inputs in the production of other goods or services. Typically, agricultural produce such as grain is sold as a bulk commodity through intermediary organisations before then reaching end users.

People that produce commodities are referred to as “price takers”. This means that an individual producer has no control over his/her price. On any day, they must take what the market offers them.

A company’s product is a differentiated product if it is uniquely different than those of competitors. If the product is different, the producer can make the case that it is better, and if it is a better product, the company can charge a higher price for it. Hence, the producer of a differentiated product is said to be a price maker rather than a price taker. A price maker has some influence over price. Essentially a producer of a differentiated product creates a separate market for his/her individual product. Importantly though, this is only if the perceived value of the product to the consumer is greater than the price. You must convince the consumer that it is better.

For Berkshire Triticale the above is relevant for both the pork producer and also the grain grower. Pork producers identified the need to establish the value of Berkshire as a product of value to them, through the provision of technical data. (i.e. the end user needs to be convinced of its value).

For the grain grower there is potential to market Berkshire triticale as a differentiated product based on establishing this value, thereby potentially being able to obtain an improved price.

**Why a supply chain?**

In an environment of uncertainty and volatility, some security and stability is a good risk hedge for both grain growing and pork producing businesses. A supply chain model aims to focus on the longer security of supply of grain before the focus on the spot price in order to flatten the peaks and troughs in the commodity price. Participants ultimately focus on the supply chain and efficiencies that can be gained to the benefit of both parties. Relationships within the supply chain are very important. Ultimately, it is about establishing surety of supply and minimising price fluctuations.
Components of a Berkshire supply chain

A supply chain that provides Berkshire triticale to pork producers contains the following elements:

Production

Berkshire triticale is produced by a grain grower. Here, seed is sourced, sown, the crop husbandry is managed, the crop matures and is then harvested.

Logistics and Storage and Handling

Logistics is important in two stages. Immediately post harvest, the triticale crop needs to reach grain storage. Typically, this could be on farm of either the producer or the consumer, or may sometimes be in an intermediary’s storage. Alternatively, there could be segregated facilities at a bulk storage and handling facility.

If not stored directly post harvest with the consumer, logistically when sold, the crop must be delivered. This could be using the producer’s or end-user’s trucks or could be via an external carrier. These deliveries need to be coordinated at the producer, consumer and carrier ends.

Administration

Administration will involve records that provide detail in regard to grain quantity and quality. It may also include crop management and paddock of origin records. There may be an intermediary such as a grain broker that assists in managing the sale. There may be a broker’s note and a grain purchase contract stating contract terms. There will also need to be a tax invoice created so that payment can be made. Grain deliveries, payments and sales should also be reconciled.

End-user

In this instance the end-user is the pork producer who is utilising Berkshire Triticale as an energy source within the ration.

A successful Berkshire supply chain.

During focus group discussions, pork producers and grain growers were asked to identify critical factors for an effective supply chain for Berkshire triticale. Factors identified included:

- The culture between the two parties involved need to align
- A non adversarial approach is needed to be taken by both sides
- A non commodity focus needed to be in place, where thinking has moved beyond the traditional spot pricing mechanism used to determine prices. However, prices must also be realistic.
- Maintenance of strong relationships are key, with trust being a prime factor
- The market should be viewed as boutique, with the value of Berkshire understood by pork producers, backed up by the provision of technical data.
- A portfolio approach to grain inputs for pork producers needs to underpin the strategy. The approach is not an “all or nothing” scenario. Berkshire forms part of a ration, there is a very good reason for Berkshire forming a percentage of that ration and the rest of the ration is adjusted around triticale at a defined price
• Both the grain grower and purchaser must either have, or be able to access, appropriate infrastructure so that grain can be safely handled, delivered and stored, with quality maintained.
• Security of supply needs to be guaranteed. The principle is supply, then price.
• It was acknowledged that price (despite the “supply then price” ideology) will still be a key driver of participation in the supply chain.

Selection criteria for a Berkshire supply chain – who fits?

From the responses above, selection criteria for participation in a Berkshire Supply chain were developed. These included:

• Non adversarial, with a desire to be in a supply chain and work cooperatively
• Win:win, with both parties believing they are “on a winner”
• A long term outlook rather than short term. Both parties “in it for the long term”
• Arrangements need to take into account cashflow requirements of participating parties
• Relevant risks for both parties must be disclosed, upfront with no surprises
• A plan is formulated to manage risks
• Both parties prepared to share the risk
• Risk management must be win:win
• Not reliant on the spot market
• Play by the rules
• Surety of supply
• A value set including integrity, honesty, empathy
Based on the above, a checklist for participation was developed.

**Berkshire Triticale Supply Chain Participant Screening Checklist**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Both Parties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Appropriate culture, ethics and values (i.e. integrity, honesty, cooperates with and empathic to, others)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Understands how a supply chain works (compared to a commodity approach) and wants to participate in a supply chain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Able to work collaboratively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Willing to commit to a medium term arrangement that is win-win for both parties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Willing to share and manage risks in an agreed way (even when it hurts!)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Payment terms timed to meet cash flow needs for both businesses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Storage costs are recognised by both parties and accounted for in price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Grain handling and storage equipment that supports timely and safe loading, unloading and delivery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Agree to administer and pay required end point royalties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Agree to, and be bound by, contract terms in a formal executed contract</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grain Grower only</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Has a sound agronomic track record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Will include Berkshire triticale in the rotation for a minimum period (e.g. 2-3 years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Able to guarantee grain supply (i.e. either produces, or is able to source, an agreed substitute if Berkshire is unavailable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pork Producer only</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Will purchase grain for the term of the contract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Payment for grain is timely and reliable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Benefits of a Berkshire supply chain

Both pork producers and grain growers were asked to identify potential benefits from participation in a supply chain. Benefits identified included:

- Instigation of communication between the producer and the consumer, working together for a common goal
- Establishment of a successful supply chain model for triticale that could potentially be extended to other commodities.
- Establishment of an alternative grain to feed barley or feed wheat in the marketplace

Grain growers also identified the ability to be able to extend crop rotations with an alternative crop type, and perhaps the ability to access other markets (i.e. dairy).

Issues identified by pork producers

One potential issue identified by pork producers was poorer quality of triticale straw for use in straw-based shelters. Triticale straw is not as highly regarded as barley straw. They also indicated that relative commodity yields also need to be better understood.

Pork producers also identified a need to understand more about Berkshire triticale’s performance within a mash feed ration. Data from feeding trials is required to better understand its performance. They also indicated that nutritive value variations from season to season needed to be understood, with pricing related to this feed value. Maintenance of quality during storage was also a concern, given that triticale is very susceptible to attack by stored grain pests.

Supply chain models

Following focus group discussions, two supply chain models were scoped and developed by Rural Directions Pty Ltd which could be applied to Berkshire triticale.

Average Pricing model

Traditionally, triticale is priced relative to both wheat and barley. Commonly, its spot price sits between feed barley and APW wheat. The Average Pricing model uses a simple rolling average wheat price based off APW wheat, relative to a rolling average F1 feed barley value, to determine an average contract price for Berkshire triticale.

Principles of the Average Pricing model are:

- The pricing formula need to be transparent and relatively simple
- A rolling average keeps the price data inline with medium term commodity trends.
- Consistent contract delivery timing should be used (i.e. November and December) in each year.
- Pricing must remain relevant to the marketplace. If you have an upwards or downwards commodity trend then the rolling average method allows commodity trends over time to be reflected in the price.
- Entry and exit strategies should be understood by both parties.
- There must be value for both the grain grower and the end-user.
The mechanism for such a contract is described below, having the following elements:

- A final Berkshire Triticale price is set using a three-year rolling average, where each October the most aged data (greater than three years) is removed to allow new price data to "roll" into the next 12 months. This creates the rolling average and keeps the price "fresh".
- A pricing point is set midway between average APW and the F1 barley price.

To avoid poor volume (liquidity) abnormalities, price data should be sourced from the most actively traded commodity relative to the time of the year:

- With wheat:
  - The preharvest price data should be sourced from the more actively traded APW Multi grade contract value.
  - Harvest and post-harvest data should be APW1 fixed grade as this is more relevant.
- F1 barley prices are sourced for fixed grade pre-harvest, harvest, and post-harvest.
- Use published external grain prices, as reported in a publication such as Rural Directions’ Market Directions report on a specific day of the week (i.e., Wednesday). This creates an unemotional, independent pricing benchmark.
- Data is generated from the first of October and starts with the current crop that is about to be harvested. (i.e., October 2010 would be for the 2010/2011 production season).
- The production season changes on the 1st June from grain on hand (old crop) to next season’s forward contract (new crop). For example:
  - 1st June 2011 pricing roles to 11/12 forward market.
  - 1st June 2012 pricing roles to 12/13 forward market.
  - 1st June 2013 pricing roles to 13/14 market.
- An example of the pricing data is summarised in the table below. Prices for three seasons for APW1 wheat and F1 barley are shown. Refer to information below that shows the raw data used to generate this table.

<table>
<thead>
<tr>
<th>Season</th>
<th>APW1 Wheat</th>
<th>F1 Barley</th>
<th>Average price</th>
</tr>
</thead>
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<tr>
<td>2010/11</td>
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<td>265.10</td>
</tr>
<tr>
<td>2013/14</td>
<td>279.18</td>
<td>226.64</td>
<td>252.91</td>
</tr>
</tbody>
</table>

- Lack of liquidity in markets is an important consideration. At times, in illiquid markets, bids can be over-inflated with no tonnage actually trading. The timing above is suggested to avoid liquidity issues on both forward contracting and grain held on hand.
- A key port must be used as a reference point from which to set prices from (e.g., in South Australia, Port Adelaide is used as the price reference point).
- In each supply chain example there may be “unders and overs” in relation to freight. Each supply chain relationship will have to broadly account for these variations. However, where no major variation occurs and in the spirit of the contract then these should be left to naturally balance out.
- As an example, for an Adelaide Plains grain producer and a potential end-user based at Sheaoak Log in the lower north of South Australia:-
Grower freight discount from Adelaide to farm is close to $10/mt.
Grower freight to consumer is plus $10/mt.

Therefore, port based pricing for delivery to the buyer is relevant in this supply chain with no adjustments required for freight.

- Pricing is ex header. Where the buyer has storage and weighbridge facilities, or access to them, it is in the interest of both parties to use this to reduce double handling.

- If the consumer has insufficient ability to store the grain produced immediately post harvest, storage costs are charged by the grain producer at $15/mt, additional logistics at $5/mt and carry costs (from the 1st of January) at 10% of the price, calculated monthly (approximately $1.30/mt/month).

- The delivery period is usually November / December at sellers call.

- Payment terms are 30 days “End Week of Delivery” from date of last delivery. This assumes grain is supplied “ex header” and that grain will flow in a short time period from harvest. Assuming grain is delivered in a short period using date of last delivery creates a point of reference for deliveries and payment without adding additional administration should payment be the more standard “end week of delivery”.

- A contract is then formed through the generation of a standard brokers note. A grain broker is likely to be involved, given the mechanism described above. This is because access to records of historical grain pricing data is required. They will assist both parties in reaching an agreement. For example, a Standard Rural Directions Pty Ltd brokers note which forms a contract will include:
  - Buyer and Seller details
  - Viterra Receival Standards
  - Grain Trade Australia (GTA) terms and dispute resolution processes
  - Dispute resolution rules
  - Personal Property Security Registration (PPSR)

An example of a brokers note is included as Appendix 1.

**Contract Farming Model**

A focus group of grain growers proposed a contract farming model for the production of Berkshire triticale. The components of the contract farming model include:

The grain grower:

- Outlines suggested management, with cost estimates, prior to the commencement of the growing season.
- Provides land, management skills and labour and equipment to conduct all crop husbandry (i.e. seeding, spraying, harvest, with management as per best district practice).
- Has responsibility for growing the triticale crop. Adequate records for all in-season operations must be maintained.
- Keeps the grain purchaser informed in regard to crop progress and likely yield outcomes as the season progresses.

The grain end-user:

- Pays a land lease fee
- Funds all crop husbandry operations at commercial rates (i.e. seeding, spraying and harvest of grain).
- Pays an invoice provided by the grain grower that includes land lease and all crop husbandry operations. Detailed records substantiating activities must be supplied with this invoice.
The end-user then owns all of the grain produced, at cost. This means that in low production years the cost of grain per tonne is likely to be high, whereas in high yielding years the cost per tonne of grain is likely to be low. This reflects the usual supply and demand influenced pricing reflected in the spot market.

Such an agreement would need to be formalised through the execution of a contract that detailed all terms and conditions. This could again be achieved through the use of a brokers note. An agronomist could also become involved to ensure that estimated production costs are realistic.

An example of a contract farming scenario is provided below.

**Establishing a contract in South Australia**

**Pork producer information session**

In South Australia there were a number of pork producers that attended an information session on the Berkshire triticale supply chain concept. At this session they were introduced to supply chains and how they worked, and were provided with information on the performance of Berkshire from both the grain grower and pork producer perspectives. They then explored what was important within a supply chain for them in particular, and discussed the possible supply chain contract models.

In total, there were five pork producers that expressed interest in using a quantity of Berkshire triticale within their rations. Total required tonnes were 1275t.

**Grain grower information session**

A similar information session was designed for grain growers. After a poor response to invitations to attend a session at Freeling in SA’s lower north, this session was moved to the Mallee region, and attendees were invited to attend a follow on grain market briefing session at no cost, in an attempt to try to attract attendees. In total 15 grain growers who were known previous triticale producers were invited to attend. However, only one business chose to participate. Of the 15 invitees, a number no longer included triticale within their cropping programs, and had no intention of doing so. It was the one attendee who suggested the contracting farming model as a possibility.

**Exploring the contract farming model**

During the pre seeding period in 2013 the contract farming model was explored in more detail by a grain grower in the Mallee of SA and a pork producer in the lower north of SA. Note that for different regions costs will differ, depending on the intensity and yield potential of the cropping system in the area.

Production costs were developed by the grain grower, as follows:

**Operational costs**

- Cost of land $37.50 per ha
- Seeding $35 per ha
- Harvest $38 per ha
- Spraying $32 per ha
  - $8 per pass, assume 3-4 passes
**Inputs at cost**

- Treated seed @ $300 per tonne retained on farm - $22.50 per ha* at a seeding rate of 75kg/Ha
- MAP@ 25kg/Ha - $16 per ha
- Urea@30 kg / Ha - $16.50 per ha
- Sulphate of Ammonia 30-40kg/ Ha depending on season - $14- $19/ha
- Chemicals – approx. $30 per ha

* In the example it is assumed that seed for the crop is already available on farm. If certified seed needed to be purchased, typically it would be at @ $500 per tonne, equating to $37.50 per ha

Total production costs where seed is available on farm are around $269 per ha. Assuming an average yield for the area of around 1.5mt/ha, the cost per tonne to produce is $179 per tonne (i.e. $269 divided by 1.5 t/ha). Under this contracting model the grain purchaser would be invoiced for these costs.

Intrinsic to this model is that the triticale becomes more expensive if a 1.5t/ha yield is not achieved and cheaper if more than 1.5t/ha is achieved. This is displayed in the sensitivity table below.

<table>
<thead>
<tr>
<th>Yield (t/ha)</th>
<th>$ per tonne*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>538</td>
</tr>
<tr>
<td>0.75</td>
<td>359</td>
</tr>
<tr>
<td>1.0</td>
<td>269</td>
</tr>
<tr>
<td>1.25</td>
<td>215</td>
</tr>
<tr>
<td>1.5</td>
<td>179</td>
</tr>
<tr>
<td>1.75</td>
<td>154</td>
</tr>
<tr>
<td>2.0</td>
<td>135</td>
</tr>
<tr>
<td>2.25</td>
<td>120</td>
</tr>
<tr>
<td>2.5</td>
<td>108</td>
</tr>
<tr>
<td>2.75</td>
<td>98</td>
</tr>
<tr>
<td>3.0</td>
<td>90</td>
</tr>
</tbody>
</table>

*Based on $269/ha production costs

Freight to the point of delivery must also be taken into account. In this example the grain grower is located in the Mallee and the pork producer is located in the lower mid north. Freight charges could be expected to be around $30/mt at harvest.

Given the variability in production in the Mallee environment and associated price fluctuations based on yield, as well as the impact of freight costs given distances involved, the pork producer chose not to participate in this model.
This was because in his view he was bearing the majority of the risk with the arrangement. There was also a disincentive given the freight component, which could have been overcome by using a grain grower in closer proximity to the pork producer.

A contract in SA

Of the pork producers that expressed interest following the focus group, one decided to continue with his existing strategy of using pellet-based rations. Another had a discussion with his nutritionist who was reluctant to include Berkshire in rations due to unfamiliarity with its performance in pig rations. Another two interested producers were situated in locations where freight costs were likely to be substantial due to the distances involved.

A Berkshire triticale crop, however, was produced in the 2013-14 season as part of this project, in the lower north of SA.

One of the 15 grain grower businesses initially approached, although not attending a workshop, agreed to plant Berkshire triticale with a view to developing a supply agreement with a pork producer, also located in the lower north of South Australia.

Of interest is that the pork producer is also a grain grower who currently grows Berkshire triticale, but is in the process of scaling back production on his own property if favour of more profitable crop alternatives. He was interested in using Berkshire triticale in rations, but did not wish to grow the crop himself.

The Berkshire grain grower and the pork producer met with Rural Directions Pty Ltd personnel Chris Heinjus and Tony Craddock to discuss a grain supply agreement.

At this meeting they were presented with the data for the average pricing model. The grain price data for previous seasons for both F1 Barley and APW wheat are presented below. Data was obtained from the Rural Directions’ price information service Market Directions, on a Wednesday.

**Year 2013-14**
Year 2011-12
Year 2010-11

The table below provides a summary of the above pricing and presents an average price across the four seasons. Hence, the suggested price for the Berkshire triticale using the average pricing model was $249.61 per tonne. Interestingly, this was very near the average between APW1 wheat and F1 barley at the current season 2013/14 prices at the time.

<table>
<thead>
<tr>
<th>Season</th>
<th>APW1 Wheat</th>
<th>F1 Barley</th>
<th>Average price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010/11</td>
<td>303.09</td>
<td>220.88</td>
<td>262.00</td>
</tr>
<tr>
<td>2011/12</td>
<td>229.26</td>
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<tr>
<td>2013/14</td>
<td>279.18</td>
<td>226.64</td>
<td>252.91</td>
</tr>
</tbody>
</table>

At the time (November 2013), the cash price for feed barley was around $200 per tonne. Given this, the pork producer was reluctant to pay the price suggested by the average pricing model. The conclusion was that both parties still wanted to enter into a supplier – buyer arrangement, but that actual pricing would be determined at a later stage.

Post harvest, in mid January of 2014 both parties independently conferred to determine a sale price. At that stage, the tonnage was known (175 tonne). The grain grower and pork producer reverted to what is current common practice for pricing grain, being spot market prices. In this particular instance they used a price based on the local feed wheat market at the time. Local mills, including Ridley’s and Laucke’s were offering $240 to $245 a tonne for feed wheat. Using this as an indicator, the triticale was then priced at $235 per tonne effectively discounting it to the
spot market feed wheat price at the time. The contract was struck via a verbal agreement with no formal documentation.

An interesting comparison is to compare the ASW1 wheat price at that time which was then $255 per tonne. This indicates that the price struck for the triticale grain sale was perhaps a greater discount than it should have been.

**Triticale as a commodity in South Australia**

*Planting of Triticale in South Australia*

The data below shows the estimated production of triticale produced in South Australia in the 2013-14 growing season, across the state. Note however, that this data should be used with caution, as these are based on estimates by district agronomists.

The Rural Directions Pty Ltd grain marketing team, who operate in the grain market on a daily basis, believe that these numbers are significantly overestimated. Of the Rural Directions grain marketing client base, less than 1% include triticale within their cropping program.

<table>
<thead>
<tr>
<th>District</th>
<th>Hectares sown</th>
<th>Tonnes produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Eyre Peninsula</td>
<td>1500</td>
<td>2100</td>
</tr>
<tr>
<td>Lower Eyre Peninsula</td>
<td>500</td>
<td>1700</td>
</tr>
<tr>
<td>Eastern Eyre Peninsula</td>
<td>4000</td>
<td>6500</td>
</tr>
<tr>
<td>Yorke Peninsula</td>
<td>2000</td>
<td>7000</td>
</tr>
<tr>
<td>Upper North</td>
<td>2500</td>
<td>5800</td>
</tr>
<tr>
<td>Mid North</td>
<td>3000</td>
<td>10000</td>
</tr>
<tr>
<td>Lower North</td>
<td>500</td>
<td>1500</td>
</tr>
<tr>
<td>Kangaroo Island</td>
<td>300</td>
<td>900</td>
</tr>
<tr>
<td>Central Hills and Fleurieu</td>
<td>1500</td>
<td>4500</td>
</tr>
<tr>
<td>Lower Murray</td>
<td>6500</td>
<td>8000</td>
</tr>
<tr>
<td>North Murray Mallee</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>South Murray Mallee</td>
<td>16000</td>
<td>21000</td>
</tr>
<tr>
<td>Upper South East</td>
<td>7000</td>
<td>13000</td>
</tr>
<tr>
<td>Lower South East</td>
<td>1000</td>
<td>3500</td>
</tr>
<tr>
<td><strong>STATE TOTAL</strong></td>
<td><strong>49300</strong></td>
<td><strong>88 500</strong></td>
</tr>
</tbody>
</table>

Although the above estimates in relation to triticale production appear significant, the crop estimates against the five year average numbers demonstrate a diminishing trend.
<table>
<thead>
<tr>
<th>Year</th>
<th>Hectares planted</th>
<th>Tonnes produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008/09</td>
<td>85700</td>
<td>86600</td>
</tr>
<tr>
<td>2009/10</td>
<td>85900</td>
<td>117700</td>
</tr>
<tr>
<td>2010/11</td>
<td>85700</td>
<td>167100</td>
</tr>
<tr>
<td>2011/12</td>
<td>80200</td>
<td>117500</td>
</tr>
<tr>
<td>2012/13</td>
<td>69200</td>
<td>95920</td>
</tr>
<tr>
<td>5 year average</td>
<td>81300</td>
<td>117000</td>
</tr>
<tr>
<td>2013/14</td>
<td>49300</td>
<td>88500</td>
</tr>
</tbody>
</table>

These estimates indicate that the importance of triticale in South Australia as a crop is diminishing, with the 2013/14 figures reducing in both area sown and tonnes produced.

**Performance of Berkshire triticale in SA**

The 2013 season South Australia trial results for triticale for the National Variety Trial (NVT) network of trials are shown below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest Town</td>
<td>Greenspatch</td>
<td>Turrellfield</td>
<td>Pinacoo</td>
<td>Consura</td>
<td>Minnopa</td>
<td>Pickhiggs</td>
<td>Barrie</td>
</tr>
<tr>
<td>Variety Name</td>
<td>Abacus</td>
<td>Berkshire</td>
<td>Chopper</td>
<td>Endeavour</td>
<td>Fusion</td>
<td>Goanna</td>
<td>Hawkeye</td>
</tr>
<tr>
<td>Site Mean (t/ha)</td>
<td>5.11</td>
<td>5.57</td>
<td>5.51</td>
<td>4.79</td>
<td>6.23</td>
<td>5.26</td>
<td>5.93</td>
</tr>
<tr>
<td>CV (%)</td>
<td>6.13</td>
<td>6.86</td>
<td>6.86</td>
<td>6.61</td>
<td>6.45</td>
<td>7.04</td>
<td>7.56</td>
</tr>
<tr>
<td>Probability</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LSD (t/ha)</td>
<td>0.56</td>
<td>0.51</td>
<td>0.49</td>
<td>0.51</td>
<td>0.51</td>
<td>0.57</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Berkshire performed credibly in comparison to the other available triticale varieties. Performance in the 2013 season is compared to long term averages (2006 to 2013) and presented in the graphs below. (Source: National Variety Trial (NVT) website).
Murray Mallee

South East
Upper Eyre Peninsula

Adjusted Average Yield

Lower Eyre Peninsula

Adjusted Average Yield
The role of triticale in South Australian farming systems

To gain information on the role of triticale and in particular Berkshire in SA farming systems current growers of triticale and 2013 Berkshire triticale growers were surveyed. In addition, agronomic consultants associated with the Independent Agricultural Consultant Group in South Australia were also surveyed. Key points associated with the survey responses are listed below:-

The grower viewpoint (Berkshire triticale growers)

- In the Mallee districts of SA triticale is grown to help manage highly erodible sand hills.
- Growers report that Berkshire is “very adaptable” performing well on “poor ground” but it also does well in “good soils”.
- One grower reported that it performs better than wheat or barley in his low rainfall heavier soils environment.
- Several growers reported using Berkshire as the first crop after a clover/grass pasture ley (i.e. Pasture – Berkshire – Wheat- Wheat/Barley-Pasture).
- Others employing intensive cropping rotations grow Berkshire triticale at the end of a cereal phase (i.e. Wheat- barley- triticale) which is then followed by a break crop (canola or peas).

The agronomist viewpoint (triticale in general)

- Growers will sometimes grow triticale as a crop option that can be harvested last (in a large cropping program) with less risk of grain or quality losses. It is quite resistant to weather damage at harvest and can be left as a standing crop for a considerable period of time.
- Others grow it on sand hills to provide soil cover as an alternative to cereal rye.
- It has rotational benefits and is an option for extending cereal-based rotations. It has few foliar disease issues, and tolerates root diseases very well (e.g. a non host for *pratylenchus* nematodes). In practice, however, most growers choose barley to extend a cereal rotation.
- It can be useful on steep and stony land as its tall growth habit enables harvesting with a lower risk of damaging machinery.
- It is useful on soil types less suited to other crops - for example, low pH soils and hard setting red soils.
- It can also fit in as a dual purpose crop, and can be either grazed, cut for hay or harvested.

Barriers to uptake of triticale by South Australian growers

The grower viewpoint (triticale in general)

The following responses were provided by grain growers who had previously grown triticale and were invited to attend the grain grower information session.

- A significant number of these growers no longer grew triticale, and indicated they were unlikely to re introduce the crop in the future.
- Other growers contacted were significantly reducing the area of triticale planted and were considering exiting the crop altogether (although they were yet to do so).
- Hard-seededness and contamination of subsequent crops, difficulty in finding a market, unreliable payment of some sectors using triticale in rations, lack of weed competitiveness, and the need to store and handle an additional grain type were all mentioned as disincentives to triticale growing.
- Several grain growers mentioned the need to consult with their agronomist if they were considering growing triticale, and the variety Berkshire, within their cropping program.
The grower viewpoint (Berkshire triticale growers)

The following responses were reflected by growers who grew Berkshire triticale in 2013.

- Marketing and logistical difficulties were reported as key barriers to the production of Berkshire triticale by growers.
- Limited available storage/delivery at harvest time is a key barrier. Several Berkshire grower expressed frustration about having to store the grain on farm after harvest.
- Limited market opportunities was also mentioned as a barrier.
- One grower reported that triticale areas had reduced substantially in his local district since Viterra had ceased to operate a local segregation. Growers had ceased production due to reluctance to freight their triticale additional distances to another delivery site.
- Consistency of demand was mentioned as a frustration and a barrier to Berkshire production. A grower reported that demand for Berkshire from a key SA feed processor varies according to price relativities with other grains at the time. Another grower reported his feed processor did not buy triticale in all years.
- Lack of storage capacity at a key feed processor (resulting a need for growers to provide on-farm grain storage for triticale) was mentioned as a barrier/disincentive for growers.

The agronomist viewpoint (triticale in general)

- Lack of markets. It is perceived to have no market and not much value.
- In a number of cases when growers sold triticale to dairies, getting paid was a problem.
- Triticale contamination of subsequent cereal crops was mentioned by several agronomists surveyed.
  - Agronomist quote: Triticale is hard seeded and causes problems by contaminating crops for 2-3 years following the original triticale crop.
  - Agronomist quote: “Farmers growing triticale tend to get it everywhere, so it’s not a good option for growers with durum or malt barley in the rotation”.
- Growers are trying to limit the number of crops and varieties. Adding triticale into the cropping program adds complexity, rather than streamlining cropping efficiency.
  - Agronomist quote: “It becomes just another crop type that needs to be managed and segregated on farm which adds complexity to the business for little apparent advantage”.
- The economic returns aren’t significantly better than growing wheat in most cropping regions as the price is at a discount to wheat and the yields aren’t significantly higher.
- It is very prone to frost damage.
- Triticale is generally a poor competitor with weeds (especially ryegrass) given its low tillering ability, particularly at early crop stages.
- There is limited investment in breeding programs – “It’s the poor cousin to wheat” according to one agronomist surveyed.
  - Agronomist quote: “It’s a crop with an image problem”.
- Another potential issue is handling the long and tangly straw – as a result, in higher rainfall areas most growers remove the straw by baling which potentially adds another cost.
- Berkshire only yields similarly to Tahara which is disappointing. Newer varieties like Hawkeye and Jaywick, significantly out yield Tahara.

Enablers for the uptake of Berkshire triticale (Growers and Agronomists)

- Secure, consistent and stable markets, prices that match wheat, multiple delivery sites that take grain at harvest to minimise on-farm storage (i.e. so growers don’t have to store triticale throughout the year).
- Price. There needs to be a premium to cover the logistics of growing another species and the possible downgrades in future crops from contamination.
- The only way for it (Berkshire) to get adopted is to have a price premium over other varieties.
• Berkshire needs to be priced to reflect the higher energy yield. Pork and chicken producers would need to recognise the value of the higher energy product and be willing to pay more for it.
• Offer area based contracts to growers and ensure that the product was priced at no less than $20 below APW wheat at any point in the year the grower chooses. If this was the case, it could be a semi-attractive option for the people who already grow triticale.

Conclusions and Recommendations

Conclusions and recommendations from Rural Directions consultants involved in the delivery of the Berkshire Triticale project are as follows:-

Fit for Berkshire triticale

Berkshire triticale will struggle to find a place in the rotation for most grain growers unless a price premium over competing feed grains is likely and some of the identified barriers to its production are addressed.

The most likely market that currently exists for Berkshire Triticale remains with mixed pork/grain businesses where both a grain growing and a pork production enterprise are conducted. To increase the area grown to Berkshire triticale, it is recommended that this “Grower-User” market segment is focussed upon.

Specialised feed grain development

To establish a market for a specialised feed grain cultivar it needs to be attractive to both the grain grower and the pork producer.

For the grain grower this will be principally driven by:-

• Achievement of yields and prices that result in similar or better gross margins than other cereal grain crops.
• Good agronomic performance with minimal disadvantages compared to other grain crop alternatives
• The existence of a supply chain with minimal logistical difficulties (i.e. readily accessible delivery points, minimal reliance on on-farm storage)
• Continuity of markets and market demand

Pork producers need to be convinced of the superior attributes of such a cultivar within their production system and need to be prepared to pay a competitive price from a grain grower’s perspective.

This will be difficult to achieve given that feed grain purchase decisions are principally driven by the goal of procuring energy and protein at the lowest possible price.

For this reason, and given the substantial cost of variety development, we recommend that the Pork CRC should not be involved in plant breeding of specialised, niche varieties.

It is envisaged that existing plant breeding programs of mainstream species and varieties will meet the feed grain needs for the pork industry.
Pork Producer education campaign

Evidence from this project suggests that pork producers will naturally choose to continue to operate in the spot market for grain acquisition needs. The industry is not yet mature enough to successfully operate within a supply chain model. For this to change the industry may need to experience a grain supply and price shock, where pork producers are perhaps forced to purchase grain at import parity prices.

In the interim, pork producers need to understand the current feed grain market they are operating in. They require knowledge, an appropriate skill set and tools to effectively manage grain price risk, given feed grains are a key input for their businesses.

To achieve this, an awareness campaign and follow up skills development workshop program is suggested.

An awareness campaign could be used to highlight the risks associated with feed grain supply in Australia, the need for industry participants to understand how the feed grain market operates and detail why price risk management is important. The role of a supply chain relationship can be canvassed as a topic as part of the exercise. The awareness program could be delivered via articles in pork industry publications, the rural media and presentations at pork industry conferences and expos.

Following on from the awareness campaign a workshop program focusing on education and skills development for pork producers is recommended. A workshop program could include the following topics:

- Principles of price risk management
- Development and maintenance of relationships within a supply chain
- Contract law
- Contract management
- Forward contracting
- Grain trade rules and the role of Grain Trade Australia
- The use of grain swaps and other risk management products
- The concept and use of price deciles in guiding pricing decisions
- Introduction to supply chains
- Pricing models for feed grains within supply chains (including both rolling average and contract farming those developed as part of this project)
- Personal properties securities act
  - Personal properties securities register (PPSR)
  - Personal Money Security Interest (PMSI)

To ensure implementation of principles from the workshop program, coaching support to individuals is recommended to increase the likelihood of adoption by workshop participants. This could include facilitation of meetings between pork producers and grain growers to develop supply chain arrangements for feed grains, and assistance with contract and agreement development.
Supply chain development

Failure to establish a successful supply chain in SA is probably due to the vehicle (Berkshire triticale) having considerable limitations from the grain grower’s perspective. This resulted in a lack of willing grain producer participants.

Despite this outcome, it should be noted that throughout the conduct of the project there was recognition of the advantages of a supply chain approach in relation to feed grains and support for the broad concept from both pork producers and grain growers.

It is suggested that there is merit in testing the supply chain concept again, but with a more mainstream commodity such as wheat or barley.

References

7. Waratah Seed company Brochure (March 2011), Berkshire Triticale
Appendix

Example of a Confirmation of Trade (COT) for Berkshire triticale

Broker's Confirmation of Trade

Attention: / Gavin Citizen  
Company: F Laucke Pty Ltd / Citizen Group trading as A & AA Citizen  
Fax: / Email: aclarke@ruraldirections.com

Rural Directions Pty Ltd, acting as broker, is pleased to confirm the following transaction.

Buyer Customer Name: F Laucke Pty Ltd, PO Box 11, DAVEYSTON SA

Seller Citizen Group trading as A & AA Citizen, PO Box 555, FREELING SA 5372

ABN 94 007 519 833

ABN 44 444 444 444

PPSR Registration No: TBA

NGR Number: 111111

Commodity: Triticale of season 2013/2014

Tonne: 17K metric tonnes at 1% moisture or 1/2 metric tonne of

Price: $249.61 per Metric Tonne

Standards: As per GTA receival standards for season 2013/2014

Delivery Terms: 20 days end of week of delivery to contract

Delivery Date: 1st November 2013 - 31st December 2013

Location Differentials: Not Applicable

Buyer Contract Number: TBA

Broker Reference Number: RD42710

Special Terms: Price basing point - Delivered Mill - Daveyton

Base price is for bin grade Berkshire Triticale of season

Flat price - no premiums or deductions for protein, screenings or moisture.

Buyers Call

Payment to occur on delivered weights not shrunken weights.

Additional freight costs account buyer.

Levies account seller.

Grain Trade Australia (GTA)

Unless otherwise specified this contract expressly incorporates:

1. The GTA Trade Rules (or standard GTA contract reference) in force at the time of this contract.

2. The GTA Contract Number 3 Standard Terms and Conditions in force at the time of this contract.

3. Dispute Resolution Rules in force at the commencement of the arbitration, under which any dispute controversy or claim arising out of, relating to or in connection with this contract, including any question regarding its existence, validity or termination, shall be resolved by arbitration.

Ownership/Conveyance

The risk of loss and / or damage shall remain with the seller until the goods have been conveyed to the buyer at the designated point of conveyance.

1. On Ex Farm, Ex Store contracts; risk passes at the time when the goods are accepted by the carrier via the appropriate documentation.

2. On Delivered or Delivered Basing Point contracts, risk passes at the time the goods are constructively placed, or presented for unloading, or otherwise made available at the buyer's original destination.

3. On In-Store contracts; risk passes at the time of transfer and / or filing of documents (if required), unless and to the extent warehouse tariff, warehouse receipt, and / or storage contract assumes the risk of loss and / or damage.
Broker's Confirmation of Trade

Personal Property Securities Register (PPSR)

Unless otherwise agreed, title to goods, as well as property in the goods, remains with the Seller until all amounts payable under this contract have been received in cleared funds in the specified bank account.

This clause creates a Purchase Money Security Interest (PMSI) for the purposes of the Personal Property Securities Act 2009 (Cth) ("PPSA"). Where permitted by the PPSA, the parties contract out of the provisions listed in sub-clauses 115(1)(a)-(c) of the PPSA. The parties agree and undertake (including for the purposes of section 275(6) of the PPSA) that the terms of this contract shall be kept confidential to the parties at all times.

Product Disclosure Statement (PDS)

It is the buyer's responsibility to provide a PDS to the seller for this contract if required.

Goods and Services Tax (GST)

Price is quoted GST exclusive. Buyer is to pay GST as per ATO legislation.

Contract Amendment

None

Crop Lien

Nothing Declared

Seller's Brokerage Fee

Seller's Brokerage Fee to be included in the Rural Directions Pty Ltd Grain Marketing Service (GMS)

Regards

Chris Heinjus

Australian Financial Services (Licence No 221556)
Appendix 7: An assessment of the Berkshire supply chain system in WA

Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

By

Dr Jo Pluske
SciEcons Consulting
Subiaco WA 6904
AUSTRALIA

Professor John Pluske
Murdoch University
Murdoch WA 6150
AUSTRALIA

March 2014

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Executive Summary

The Pork CRC for an Internationally Competitive Pork Industry provided funding for the development and release of the high yielding and highly digestible triticale variety, Berkshire. Triticale can be grown in rainfall zones from 200mm to 1200mm and has similar agronomic requirements to wheat. It is primarily included in livestock diets as an energy source and has similar chemical and physical properties to wheat. Further, it has a softer grain than wheat and barley so can be easier to mill for livestock diets, however it may be more susceptible to insect damage in long term storage.

The aim of this project was to provide a guide for a triticale supply chain that could be economically and environmentally efficient for the Australian pig industry in WA. To achieve this aim it was expected that a sustainable production of 10,000 tonnes of Berkshire triticale would be necessary and hence the need for development of a prototype triticale supply chain in WA. Hence contact was made with agronomists, growers, grain buyers, those involved in feed manufacture and pig producers.

Generally the agronomists that we met with were interested in Berkshire but not convinced that they should promote it especially given the recent poor seasons. Follow-up with them in 2014 indicated that there was still little interest primarily because growing wheat was perceived of being less risky to grow and the expected gross margin was higher for wheat than that for triticale. Whilst there was some agronomic evidence that indicated it was advantageous to grow Berkshire, there was a lack of trial data specifically for WA and in particular data showing for example, a comparison of wheat and Berkshire on acidic soils. There were also some reservations about what triticale variety to grow because none are specifically recommended for WA and in other States the messages are mixed, with for example Hart Bros recommending Fusion\(^1\). A survey of grain growers also indicated that Berkshire was not being considered for the 2013/14 season.

Pig producers were receptive to the idea of increasing the level of Berkshire in their diets and were keen to work with others in the supply chain to discuss a market price. The general outcome was that Berkshire was viewed as a feed grain and so should be priced accordingly within that range. They were keen to develop a "Hectare-Based Berkshire" contract, and one was released by a WA company called Grain Link for grain producers. However, there ended up being very little interest in this contract on the part of grain producers and so contracts were not written for the 2013/14 season. The main reason for lack of interest was that the financial incentive was not enough.

Known seed sales of Berkshire have taken place in Western Australia from 2009 to 2012. To date though there has not been an official premium paid for Berkshire. Without expensive testing, it is also difficult to detect Berkshire from other triticale varieties. Hence, there is little incentive on the part of the grower to declare a triticale crop as Berkshire. Due to this obscurity, the quantity of Berkshire in the supply chain remains ambiguous. Modelling suggests that there may be somewhere between 3,000 and 5,000 tonnes of feed available with seed kept for 2,000 to 5,000 hectares. Whilst these figures are speculative, they provide an insight into what the current situation regarding Berkshire in WA might be and the potential that could be reached with favourable conditions.

To retain the plant breeder’s rights (PBR) for Berkshire, an annual registration renewal fee must be paid for the protection period. Once the PBR has expired, the variety reverts to the public domain and is available to everybody. There have been 29 varieties of triticale registered for PBR in Australia with only 15 still having an active PBR status. The issue of whether the PBR status should remain active on Berkshire is ripe for debate. Currently there isn’t any incentive to declare a variety as Berkshire by either the grower or buyer and it is difficult to obtain proof as to what variety a triticale actually is.

Additional supply options and (or) financial incentives such as those that might originate out of a food grain market may induce some enthusiasm in triticale production. Dennett et al. (2013) presented results of the baking characteristics and food value of triticale (including Berkshire). They concluded that there was potential for triticale to be used as a flour substitute to wheat for some goods. This research is


particularly encouraging in that if there is a food market for triticale, the spin-off for the feed industry may be positive.

Triticale is grown in Western Australia as an option for grain growers and buyers. Whilst it might grow well on acidic soils, grain growers are hesitant to grow it due to what they perceive to be a lack of financial incentive. Despite what feed formulations might suggest, buyers prefer to buy it at around $20 to $30/t less than what they are willing to pay for wheat. Given the grain-growing substitutes available, triticale growers are generally price takers and hence have little incentive to produce triticale. If pig producers are serious about having triticale in their rations then they have to ensure supply.

Overall it can be concluded that whilst there is adequate communication within the supply chain, demand for Berkshire is spasmodic with price incentives being limited due to seemingly adequate supply of alternative grains. Further, supply of triticale is irregular and after poor seasons is unlikely to be grown unless the grain producer has adequate resources to use it as a break crop or receives a price incentive to grow it.

As a result of the outcomes derived from this study the following recommendations have been made:

1. Endorse triticale varieties as energy substitutes for wheat to encourage triticale demand;
2. Encourage feed buyers to communicate with triticale growers to stimulate supply;
3. Remove the PBR status from Berkshire;
4. Follow the progress of triticale as a food grain and use any positive developments to benefit feed grain.
# Table of Contents

Executive Summary

1. Introduction

2. Methodology

3. Results

3.1. Meeting with WA agronomists

3.2. Identification of potential growers

3.3. Meeting with WA pig producers

3.4. Estimating the amount of Berkshire in WA

4. Berkshire and plant breeder’s rights

5. Alternative uses for triticale

6. Discussion

7. Conclusion

8. Recommendations

9. Acknowledgements

10. References

Appendices

Appendix 1: Press release 2010

Appendix 2: Press release 2012

Appendix 3: Grower fact sheet for Berkshire

Appendix 4: DEPI descriptions of triticale varieties

Appendix 5: Berkshire nutritional profile 18th April 2013

Appendix 6: Grain Link contract

Appendix 7: Intentions to grow Berkshire
1. Introduction

The Pork CRC for an Internationally Competitive Pork Industry together with The University of Sydney released the high yielding triticale variety, Berkshire\(^2\), in 2009. It is suited to many regions of Australia and can be grown in rainfall zones from 200 mm to 1200 mm. Triticale has similar agronomic requirements to wheat but can have a higher yield potential in regions that experience, for example, waterlogging, early drought, problematic soils (e.g., ‘Wodjil’ soil type of which there are around 300,000 hectares in Western Australia), and leaf disease (Barbetti et al. 2005). Based on ABARES (2010) figures, over the period 2003/04 to 2009/10, the mean triticale yield for Western Australia (WA) was just over 1.3 t/ha over an area of around 40,000 hectares.

Triticale is primarily included in livestock diets as an energy source and has similar chemical and physical properties to wheat (van Barneveld 2002; King 2010). Further, it has a softer grain than wheat and barley so can be easier to mill for livestock diets. However it may be more susceptible to insect damage in long-term storage. According to King (2010), Berkshire contains about 0.5 MJ DE/kg more energy than the average level found in other triticale varieties.

When considering triticale as a crop, Pluske and Pluske (2011a) reported results from a survey suggesting that agronomic reasons, in combination with either profit or the market, were believed to be the most important influences over variety selection by the majority of respondents (56%). Extending upon these findings, wheat was generally preferred to triticale because it can be dual purpose, harvested earlier, may be higher yielding and usually attracts a higher price (Pluske and Pluske 2011b). They also stressed that grain growers often rely on advice from agronomists or seed providers when making a decision about growing a new variety, especially if they have not grown it before, and it was noted that the difference in seed price can be a strong deterrent if there is no guarantee of a yield advantage.

GRDC (2008) emphasized that triticale production has generally not changed in the past 30 years but there is potential for production to increase by focusing on improving yields so that the relative profitability of feed-grain production also increases. Further, their report suggested that there needs to be increased grower confidence in, and focus on, livestock producers as customers. In addition, there are high Cooperative Bulk Handling (CBH) receival standards for triticale and growers are potentially at the “mercy” of end-users who often have limited storage. They also noted that transport costs can be prohibitive and unless they have sealed silos or access to warehousing in CBH storage silos, growers are reluctant to store triticale because it is susceptible to weevils.

Grainsearch (2007) noted that implementation of feed grain supply chain groups would need consideration of their specific requirements, capacities, strengths and weaknesses and hence a customised plan for each. The aim of this project was to provide a guide for a triticale supply chain that could be economically and environmentally efficient for the Australian pig industry in WA. To achieve this aim it was expected that a sustainable production of 10,000 tonnes of Berkshire triticale would be necessary and hence the need for development of a prototype for a triticale supply chain in WA. A major requirement of this project was that the supply chain should be self-supporting without the need for an on-going moderator.

\(^2\) Berkshire\(^0\) is subject to PBR and hence the symbol denoting this. However, for the purpose of this report it is understood that Berkshire and Berkshire\(^0\) are interchangeable.
2. Methodology

In conjunction with findings from Pluske and Pluske (2011b) and by following use of the ‘de proche en proche’ or ‘friends of friends’ method of influencing stakeholders (Vanloqueren and Baret, 2008), specific players were invited to participate in this study. Hence contact was made with agronomists, grain growers, grain buyers, those involved in feed manufacture and pig producers.

Representatives from GrainCorp provided the initial contacts with agronomists, and other grain buyers. Their assistance in the initial stages of this project was invaluable. Unfortunately and due to extenuating circumstances, they had to withdraw from the project. A meeting and later contact with agronomists provided information about grower decisions with regard to crop selection and their need for information. Andrew Goyder from Grain Link became an integral part of this project and facilitated a survey with grain growers to identify potential Berkshire growers. Meetings with pig producers were held to discuss Berkshire in their rations as well as acceptable prices. Part of this process involved determining prices using least cost modelling and gross margin modelling.

GrainCorp devised some plans for setting up a receival system that was to be economically and environmentally effective for the grain producer and feed manufacturer. However, due to their withdrawal from the project and also the perceived lack of interest in growing Berkshire, these plans were shelved.

Instead, additional information was gathered as part of the need to have a better understanding of Berkshire production and use in WA. As records are not available a model was developed to estimate the amount of Berkshire that may be produced in WA. Finally an investigation into Plant Breeders Rights (PBR) for Berkshire and alternative uses for triticale was explored in a desktop study.

3. Results

3.1. Meeting with WA agronomists

Agronomists with clients around the major receival areas for triticale produced during the 2011/12 season (Table 1) were targeted and met with project participants in early 2013.

Table 1: Triticale receivals (t) from the 2011/12 season.

<table>
<thead>
<tr>
<th>Receival point</th>
<th>Receivals: 2012 harvest (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt Marshall</td>
<td>2100</td>
</tr>
<tr>
<td>Dalwallinu</td>
<td>1377</td>
</tr>
<tr>
<td>Kellerberrin</td>
<td>1044</td>
</tr>
<tr>
<td>Koorda</td>
<td>894</td>
</tr>
<tr>
<td>Merriden</td>
<td>812</td>
</tr>
</tbody>
</table>

Source: CBH

Generally the agronomists that we met were interested in Berkshire but not convinced that they should promote it especially given the recent poor seasons. Follow-up with them in 2014 indicated that there was still little interest.
Outcomes from this meeting:

1. Despite a media release made available by the Pork CRC in 2010 (Appendix 1), the agronomists thought that the focus needed to also be on the grain grower. Hence, a new media release was written and made available on 12th December 2012 and subsequently appeared in several publications including the rural press in Western Australia (Appendix 2).

2. Specific fact sheets regarding triticale production in WA are not available. A fact sheet was written (Appendix 3) but when reviewed by agronomists it was thought that more detail was required. Hence a report on Berkshire in WA (Attachment 1) was written for industry to show Berkshire yields and DE in relation to that of wheat and barley grown in WA (Attachment 1). This report was distributed to contacts in the WA supply chain. Whilst it may have provided some useful information, due to data being unavailable it still lacked some important details, such as a comparison of wheat and Berkshire on acidic soil. Nevertheless, a simple gross margin analysis was presented to provide an indication of how Berkshire compares to wheat. In locations and seasons where Berkshire outperforms wheat by for example 20%, it is possible (contingent upon prices) that it will produce a greater return than wheat. Further, the agronomic benefits from growing Berkshire may result in it being an attractive alternative for grain growers.

The agronomists were made aware of information regarding triticale in general being available from various sources including DEPI (2013) (see Appendix 4). In addition, they were directed to various fact sheets that are available from the Waratah Seeds website (http://www.waratahseeds.com.au/).

Triticale is not part of the National Variety Trials (NVT) in WA so data comparing triticale varieties is not available. The WA wheatbelt and the mallee in Victoria both produce predominately Australian premium white wheat with similar rainfall percentiles. Whilst there are obviously differences between the regions, the NVT triticale data from the mallee, reported by DEPI (2013), could provide some indication of potential yields in WA (Table 2).

Table 2: The long term predicted triticale yield (main season, the mallee, Victoria) 2005-2012 expressed as a percentage of the yield of Jaywick (numbers in brackets indicate the number of site years in that area). The yield, protein level (%) and test weight (kg per hectolitre) for the 2012 triticale trials are expressed as a percentage of the yield of Jaywick at Ultima (U) and Walpeup (W).

<table>
<thead>
<tr>
<th></th>
<th>Long term predicted yield</th>
<th>Yield U</th>
<th>Protein U</th>
<th>Test Wt U</th>
<th>Yield W</th>
<th>Protein W</th>
<th>Test Wt W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaywick (t/ha)</td>
<td>2.44</td>
<td>2.00</td>
<td>1.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berkshire</td>
<td>100 (8)</td>
<td>95</td>
<td>109</td>
<td>9.3</td>
<td>9.3</td>
<td>78.7</td>
<td>79.3</td>
</tr>
<tr>
<td>Bogong</td>
<td>102 (11)</td>
<td>107</td>
<td>120</td>
<td>9.4</td>
<td>9.3</td>
<td>78.0</td>
<td>77.3</td>
</tr>
<tr>
<td>Canobolas</td>
<td>100 (11)</td>
<td>97</td>
<td>113</td>
<td>9.5</td>
<td>9.4</td>
<td>77.4</td>
<td>76.6</td>
</tr>
<tr>
<td>Chopper</td>
<td>102 (9)</td>
<td>104</td>
<td>108</td>
<td>9.4</td>
<td>9.2</td>
<td>71.6</td>
<td>75.2</td>
</tr>
<tr>
<td>Fusion</td>
<td>104 (6)</td>
<td>107</td>
<td>114</td>
<td>9.4</td>
<td>9.4</td>
<td>74.4</td>
<td>75.8</td>
</tr>
<tr>
<td>Goanna</td>
<td>96 (4)</td>
<td>107</td>
<td>113</td>
<td>9.4</td>
<td>9.6</td>
<td>78.8</td>
<td>79.6</td>
</tr>
<tr>
<td>Hawkeye</td>
<td>103 (12)</td>
<td>104</td>
<td>109</td>
<td>9.3</td>
<td>9.5</td>
<td>76.3</td>
<td>77.4</td>
</tr>
<tr>
<td>Jaywick</td>
<td>100 (12)</td>
<td>100</td>
<td>100</td>
<td>9.3</td>
<td>9.6</td>
<td>74.4</td>
<td>76.3</td>
</tr>
<tr>
<td>Rufus</td>
<td>99 (9)</td>
<td>107</td>
<td>105</td>
<td>9.3</td>
<td>9.5</td>
<td>74.5</td>
<td>76.3</td>
</tr>
<tr>
<td>Tahara</td>
<td>97 (14)</td>
<td>106</td>
<td>100</td>
<td>9.3</td>
<td>9.5</td>
<td>74.4</td>
<td>75.5</td>
</tr>
<tr>
<td>Tickit</td>
<td>99 (10)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Yowie</td>
<td>94 (6)</td>
<td>102</td>
<td>92</td>
<td>9.5</td>
<td>9.6</td>
<td>75.7</td>
<td>74.1</td>
</tr>
</tbody>
</table>
The long term predicted yield for Berkshire was found to be comparable to the top-performing varieties. However, Fusion was expected to out-yield all other varieties and is the Hart Bros choice for a high yielding grain triticale with a good disease package. Other products that they have include Berkshire, Hawkeye, Endeavour, Chopper, Bogong and Tobruk (see http://www.hartbrosseeds.com.au/all-products/fusion-triticale.aspx).

3.2. Identification of potential growers

Based on registered seed sales between 2009 and 2012, a list of regions where triticale might be grown was made (Table 3).

Table 3: Areas where Berkshire seed was sold in WA and the year in which it was sold.

<table>
<thead>
<tr>
<th>Area</th>
<th>Year of known seed sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popanyinning</td>
<td>2009</td>
</tr>
<tr>
<td>Cuballing</td>
<td>2009</td>
</tr>
<tr>
<td>Wannamal</td>
<td>2009</td>
</tr>
<tr>
<td>Capel</td>
<td>2009</td>
</tr>
<tr>
<td>Kalannie</td>
<td>2010</td>
</tr>
<tr>
<td>Perenjori</td>
<td>2010</td>
</tr>
<tr>
<td>Boyanup</td>
<td>2010</td>
</tr>
<tr>
<td>Kellerberrin</td>
<td>2011</td>
</tr>
<tr>
<td>Pingelly</td>
<td>2012</td>
</tr>
<tr>
<td>Hyden</td>
<td>2012</td>
</tr>
<tr>
<td>Koorda</td>
<td>2012</td>
</tr>
<tr>
<td>Dalwallinu</td>
<td>2012</td>
</tr>
</tbody>
</table>

In early 2013 GrainLink sent out a fax to growers that had grown triticale before asking them their intentions to grow Berkshire (Appendix 7). Around 50% of these growers replied to this fax with only a third of these considering Berkshire as part of their 2013/14 cropping program. The 50% of growers who did not return the fax were followed up with phone calls but none planned to plant any triticale.

Due to the lack of rain especially in the more eastern regions in 2013, triticale plantings were below the expected level and as such GrainLink did not take delivery of any triticale in the 2013/14 season. A lack of rain early in the season may also result in low triticale plantings for the 2014/15 season. Anecdotal evidence suggested that Tahara yielded as well as Berkshire in the eastern wheatbelt. Whilst generally Berkshire out yields Tahara, with a lack of rain, Tahara has been shown to perform well, e.g., at Ultima in 2012 (Table 2).

3.3. Meeting with WA pig producers

Meetings with pig producers were held on 18th January, 15th February and 19th March 2013. The outcome of these meetings was to hold a joint meeting will triticale buyers and suppliers to discuss a market price.

In preparation for this meeting, nutritionist Daniel Goussac completed three feed-formulation scenarios with the aim of estimating a ‘value’ for Berkshire. In one series of formulations, he used a single-mix (typical pig finisher feed, 13.2 MJ/kg) and in the second, he used a multi-
mix (series of seven different feeds). He found that there was no significant difference in Berkshire values generated for both mixes.

With a fixed price of barley at $330/t, for each wheat price, the corresponding highest value for Berkshire was estimated to be slightly lower, $3 to $5/t, than the price of wheat (Figure 1).

![Figure 1](image1)

Figure 1. Given a moving wheat price and a fixed price of barley ( ), Berkshire ( ) was estimated to have a value between $3 and $5/t lower than the corresponding wheat price.

Setting wheat to a fixed price of $360/t and varying the barley price resulted in the value of Berkshire being estimated at around $90/t higher than the corresponding barley price when at low levels with the difference falling to around $30/t when the price of barley rose to $290/t (Figure 2).

![Figure 2](image2)

Figure 2. Given a fixed wheat price of $360/t and a moving barley price ( ), the estimated value of Berkshire ( ) was between $30 and $90/t higher than the price for barley.
Given moving wheat and barley prices, estimated Berkshire values were estimated to be greater, by around $25/t, than the corresponding barley price but between $3 and $5/t lower than the corresponding wheat price (Figure 3).

Figure 3. Given moving wheat and barley prices ( ■ ), the value of Berkshire ( ■ ) was estimated to be between $3 and $5/t lower than the corresponding wheat price.

Whilst it may be unlikely that barley or wheat prices would be fixed at such high levels, these analyses showed that the estimated value of Berkshire more closely tracks the wheat price than the barley price.

Outcomes from this meeting:

1. A nutritional profile for Berkshire was written (Appendix 5). It has since been updated to include the following table (Table 4).

Table 4. Selected analyses of wheat samples (cv. Mace, Yitpe) and Berkshire obtained from a farm in south-western Australia in the 2013 growing season and conducted at two different laboratories (Symbio and DAFWA). The difference (Diff, %) is the percentage difference between the lowest and highest values for each sample for each analysis.

<table>
<thead>
<tr>
<th></th>
<th>Symbio</th>
<th>DAFWA</th>
<th>Symbio</th>
<th>DAFWA</th>
<th>Diff, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mace (wheat 1):</td>
<td>9.9</td>
<td>9.18</td>
<td>7.8</td>
<td>13.9</td>
<td>14.09</td>
</tr>
<tr>
<td>Mace (wheat 2):</td>
<td>12.4</td>
<td>10.45</td>
<td>18.7</td>
<td>13.9</td>
<td>14.16</td>
</tr>
<tr>
<td>Yitpe (wheat):</td>
<td>12.0</td>
<td>10.94</td>
<td>9.7</td>
<td>14.1</td>
<td>14.37</td>
</tr>
<tr>
<td>Berkshire</td>
<td>10.9</td>
<td>9.46</td>
<td>15.2</td>
<td>13.6</td>
<td>13.74</td>
</tr>
</tbody>
</table>

Analyses completed January 2014
2. A "Hectare-Based Berkshire" contract was written and released by GrainLink (Appendix 6). There weren’t any growers willing to take up the Berkshire contract offered by Grain Link. However, there is possible interest from at least one grower for the 2014/15 season. The main reason for lack of interest was that the financial incentive was not enough. Even so, the major buyers in WA have shown interest in using Berkshire in their rations, although they are still focused on the triticale price being between $20 and $30/t less than wheat. Providing this is the case, (generally this is shown to actually be the case, Figure 4), when available, triticale should always appear in rations.

![Perth Grain Prices](image)

Figure 4. Estimated stockfeed wheat price (available in a region, ASW, AGP, SFW1 or FED1) (●), F1 barley price (●), and triticale (●) price based on delivery to dairy farms with allowance for freight, storage, and marketing costs, but exclusive of GST Dairy Australia (2014).

3.4. Estimating the amount of Berkshire in WA

Attempts to determine Berkshire production by directly contacting producers (Appendix 6) and by contracting agronomists were not very successful. Antedotal information from buyers suggested that there are about 20 triticale suppliers in WA, of which about half supply almost all of the total volume. CBH information indicates about 6,000 t (Table 1) were delivered to receival points during the 2011/12 season. It was expected that almost 1,000 t of triticale would be delivered during the 2012/13 season (Table 5), although Berkshire was not nominated as a variety expected to be grown. However, due to seasonal circumstances no triticale was actually received by CBH for that season.
Table 5: Expected triticale plantings and delivery to CBH port zones for the 2012/13 season.

<table>
<thead>
<tr>
<th>Port</th>
<th>VARIETY</th>
<th>Hectares Planned For Sowing</th>
<th>Hectares Planned For Delivery</th>
<th>Variety Nett Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany</td>
<td>BOGONG</td>
<td>85</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CREDIT</td>
<td>326</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPEEDEE</td>
<td>407</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TYALLA</td>
<td>58</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Geraldton</td>
<td>SPEEDEE</td>
<td>713</td>
<td>235</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAHARA</td>
<td>215</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>Kwinana</td>
<td>VARIETY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CREDIT</td>
<td>1975</td>
<td>1098</td>
<td>24.84</td>
</tr>
<tr>
<td></td>
<td>SPEEDEE</td>
<td>3673</td>
<td>1155</td>
<td>616.66</td>
</tr>
<tr>
<td></td>
<td>TAHARA</td>
<td>2137</td>
<td>910</td>
<td>319.18</td>
</tr>
<tr>
<td></td>
<td>TREAT</td>
<td>420</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VENUS</td>
<td>500</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

Source: CBH

Known seed sales of Berkshire have taken place in Western Australia from 2009 to 2012 (Table 3). Sales of grain grown from this seed are subject to an End Point Royalty (EPR). However, most sales do not go through the grain receival system and generally it is not segregated at the point of sale. Discussion with GrainCorp and CBH regarding setting up some niche segregations for Berkshire for the 2013/14 season did not progress due to the lack of indication from growers that they would indeed deliver any Berkshire.

To date there has not been an official premium paid for Berkshire. Without expensive genetic testing, it is also difficult to detect Berkshire from other triticale varieties. Hence, there is little incentive on the part of the grower to declare a triticale crop as Berkshire. Due to this obscure supply chain, the quantity of Berkshire in the supply chain is ambiguous.

In an attempt to gain an idea as to the possible tonnage of Berkshire in WA at the end of 2013, a model based on simple assumptions was used to generate estimates (Figure 1). These assumptions include 10 t of Berkshire seed being sown at 100k g/ha at each of the 12 sites listed in Table 3, with the subsequent crop yielding an average of 1.5 t/ha. The proportion of the crop retained for seed was assumed to be a value between 0.05 and 0.3 and constant across years and sites. The grain not retained as seed was assumed to be sold as feed.

If just 5% of the Berkshire crop was retained as seed it could be expected that there would be just over 1,000 tonnes of Berkshire feed available at the end of 2013 with enough seed to plant around 600 hectares. Retaining 30% of the crop would result in around 45,000 tonnes of Berkshire being available as feed and seed for 195,000 hectares (Figure 5). While such a scenario is physically possible, it is not likely. Perhaps more likely is the scenario whereby 15% of grain is kept for seed leaving around 8,500 tonnes being available for feed. Even so this would mean that there would be enough seed for around 15,000 hectares of Berkshire crop for the 2014/15 season.
Anecdotal evidence suggests that this level of Berkshire planting will not occur. Taking this same proportion but applying a dynamic multiplier so that seed retention is perhaps a little more realistic, results in an alternative prediction for Berkshire availability (Figure 6).

Given a dynamic reduction in the proportion of seed retained each year being a more likely scenario and the seasonal and market conditions in WA being unconducive to the rapid expansion of Berkshire production, it might be expected that at the end of 2013 Berkshire feed availability could be somewhere between 3,000 and 5,000 tonnes with seed available for 2,000 to 5,000 hectares.

Whilst these model results are speculative, they provide an insight into what the current situation regarding Berkshire in WA might be and the potential that could be reached with favourable conditions.
4. Berkshire and plant breeder’s rights

IP Australia (2013) explains that a plant variety can be commercialised through a contractual arrangement with a person or organisation (licensing) or by selling it directly (provided that there is no other legislation preventing that person from undertaking such commercial activities). In addition, plant breeder’s rights (PBR) also protect the registered name and synonym of the variety from use in relation to other similar plants. To retain the PBR, an annual registration renewal fee must be paid for the rest of the protection period. Once full protection has been awarded, length of protection lasts for up to 20 years provided the annual maintenance fee is paid and any conditions that may be placed on the variety are met. Once the PBR has expired, the variety reverts to the public domain and is available to everybody. The limited duration of PBR rights ensures a balance between private and public interest.

The PBR for Berkshire (shown as JRCT74) indicates comparators ‘Jaywick’, ‘Hawkeye’ and ‘Tahara’ showing differences in lower glume: length of first beak and hairiness on external surface. For Berkshire, the Most Similar Varieties of Common Knowledge (VCK) identified were: ‘Canobolas’ ‘Tahara’ ‘Jaywick’ ‘Bogong’ ‘Hawkeye’ (IP Australia 2013). Details of the application are presented in Table 6.

Table 6: Details of the PBR application for Berkshire (IP Australia 2013).

<table>
<thead>
<tr>
<th>Application No.</th>
<th>2009/025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety Name</td>
<td>‘Berkshire’</td>
</tr>
<tr>
<td>Genus Species</td>
<td>xTriticosecale</td>
</tr>
<tr>
<td>Common Name</td>
<td>Triticale</td>
</tr>
<tr>
<td>Synonym</td>
<td>Nil</td>
</tr>
<tr>
<td>Breeder’s Code</td>
<td>JRCT74</td>
</tr>
<tr>
<td>Accepted Date</td>
<td>17 Mar 2009</td>
</tr>
<tr>
<td>Applicant</td>
<td>Pork CRC Ltd, University of Adelaide Roseworthy Campus, SA</td>
</tr>
<tr>
<td>Agent</td>
<td>N/A</td>
</tr>
<tr>
<td>Qualified Person</td>
<td>Jeremy Roake</td>
</tr>
</tbody>
</table>

**Details of Comparative Trial**

<table>
<thead>
<tr>
<th>Location</th>
<th>Plant Breeding Institute, Cobbitty, NSW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor</td>
<td>Triticale (xTriticosecale) TG/121/3</td>
</tr>
<tr>
<td>Conditions</td>
<td>Each treatment was hand sown into 5 rows at 30 cm between rows, with a plot length of 5m. Plants were irrigated during the season, and sprayed with bromoxynil and glran to control weeds.</td>
</tr>
<tr>
<td>Trial Design</td>
<td>Randomised complete block design.</td>
</tr>
<tr>
<td>Measurements</td>
<td>Measurements were taken form 10 plants at random from each replicate.</td>
</tr>
<tr>
<td>RHS Chart - edition</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Origin and Breeding**

Controlled pollination: The line TSO2M F7 HR 381624 (Pedigree: Yogui 1/ Tapir//2*Fara 1/3/ Erizo 11/ Yogui 3/5/ Asad*2/ Jun// Anoa 5/3/ Sonni 6/4/ Asad/ Elk54//Erizo 10) was selected by the breeder, Jeremy Roake, at CIMMYT’s breeding station at Ciudad Obregon in Mexico. The parents are heterogenous for stem rust resistance whereas the candidate variety is resistant to stem rust. Two head selections were taken, and grown near Mexico City in a quarantine nursery. The seed from this generation was grown in quarantine at PBI, Cobbitty in 2003/04. In 2004, the line was grown at Cobbitty, and selected for stem, leaf, and stripe rust resistance. The population was segregating for stem rust, and the resistant selections were taken from the population. The line was then yield tested at Cowra in 2005, where it exhibited superior yield. The line was also selected for its high metabolisable energy for pigs, based on NIR tests. Further yield tests in 2006 and 2007 showed the line to have 8-10% better yield than the standard variety, ‘Tahara’.
There have been 29 varieties of triticale registered for PBR in Australia. Only 15 still have an active PBR status (Table 7).

Table 7: Details of the PBR status of triticale varieties in Australia (IP Australia 2013).

<table>
<thead>
<tr>
<th>Credit</th>
<th>Status</th>
<th>Credit Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jackie</td>
<td>TERMINATED</td>
<td>Adelaide Research &amp; Innovation Pty Ltd and Grains Research and Development Corporation</td>
</tr>
<tr>
<td>HERITAGE ZEPHYR</td>
<td>TERMINATED</td>
<td>University of New England</td>
</tr>
<tr>
<td>Tickit</td>
<td>TERMINATED</td>
<td>Adelaide Research &amp; Innovation Pty Ltd and Grains Research and Development Corporation</td>
</tr>
<tr>
<td>Treat</td>
<td>TERMINATED</td>
<td>Adelaide Research &amp; Innovation Pty Ltd and Grains Research and Development Corporation</td>
</tr>
<tr>
<td>Speedee</td>
<td>TERMINATED</td>
<td>University of Adelaide, Grains Research &amp; Development Corporation</td>
</tr>
<tr>
<td>Prime322</td>
<td>TERMINATED</td>
<td>The University of Sydney and Grains Research and Development Corporation</td>
</tr>
<tr>
<td>Breakwell</td>
<td>TERMINATED</td>
<td>University of Sydney</td>
</tr>
<tr>
<td>Tuckerbox</td>
<td>TERMINATED</td>
<td>Pasture Genetics Pty Ltd</td>
</tr>
<tr>
<td>Pacific Falcon</td>
<td>TERMINATED</td>
<td>Agricultural Research Council</td>
</tr>
<tr>
<td>ABACUS</td>
<td>TERMINATED</td>
<td>Adelaide Research &amp; Innovation Pty Ltd</td>
</tr>
<tr>
<td>Maiden</td>
<td>TERMINATED</td>
<td>The University of Sydney</td>
</tr>
<tr>
<td>Hillary</td>
<td>TERMINATED</td>
<td>The University of Sydney, Grains Research and Development Corporation, University of New England</td>
</tr>
<tr>
<td>Yowie</td>
<td>WITHDRAWN</td>
<td>KV Cooper &amp; MG Elleway</td>
</tr>
<tr>
<td>Eleanor</td>
<td>WITHDRAWN</td>
<td>The University of Sydney, Grains Research &amp; Development Corporation</td>
</tr>
<tr>
<td>Bogong</td>
<td>ACCEPTED</td>
<td>University of New England</td>
</tr>
<tr>
<td>Canobolas</td>
<td>ACCEPTED</td>
<td>University of New England</td>
</tr>
<tr>
<td>Crackerjack 2</td>
<td>ACCEPTED</td>
<td>Plant and Food Research</td>
</tr>
<tr>
<td>Fusion</td>
<td>GRANTED</td>
<td>Australian Grain Technologies Pty Ltd</td>
</tr>
<tr>
<td>Tobruk</td>
<td>GRANTED</td>
<td>University of Sydney</td>
</tr>
<tr>
<td>Kosciuszko</td>
<td>GRANTED</td>
<td>University of New England and QAF Feeds Pty Ltd</td>
</tr>
<tr>
<td>Crackerjack</td>
<td>GRANTED</td>
<td>The New Zealand Institute for Plant and Food Research Limited</td>
</tr>
<tr>
<td>Forerunner</td>
<td>GRANTED</td>
<td>Weaver Seed of Oregon Inc and Oregon Trail Seeds</td>
</tr>
<tr>
<td>Hawkeye</td>
<td>GRANTED</td>
<td>Australian Grain Technologies Pty Ltd</td>
</tr>
<tr>
<td>Jaywick</td>
<td>GRANTED</td>
<td>Australian Grain Technologies Pty Ltd</td>
</tr>
<tr>
<td>Endeavour</td>
<td>GRANTED</td>
<td>University of Sydney</td>
</tr>
<tr>
<td>El Alamein</td>
<td>GRANTED</td>
<td>The University of Sydney, Grains Research &amp; Development Corporation</td>
</tr>
<tr>
<td>Coral Sea</td>
<td>GRANTED</td>
<td>The University of Sydney, Grains Research &amp; Development Corporation</td>
</tr>
<tr>
<td>Berkshire</td>
<td>GRANTED</td>
<td>Pork CRC Ltd</td>
</tr>
<tr>
<td>Chopper</td>
<td>GRANTED</td>
<td>Australian Grain Technologies Pty Ltd</td>
</tr>
</tbody>
</table>

The issue of whether the PBR status should remain active on Berkshire is ripe for debate. Currently there isn’t any incentive to declare a variety as Berkshire by either the grower or buyer and it is difficult to obtain proof as to what triticale variety it actually is.

5. Alternative uses for triticale

Additional supply options and (or) financial incentives such as those that might originate out of a food grain market may induce some enthusiasm by grain growers. Dennett et al. (2013) presented results of the baking characteristics and food value of triticale (including Berkshire).
They concluded that there was potential for triticale to be used as a flour substitute to wheat for some goods.

6. Discussion

The agronomists who participated in this study were interested in Berkshire but given the lack of research data specifically for WA found it difficult to be convinced of the benefits for their clients. They perceived that there is not enough of a yield and, or price advantage for them to actively promote Berkshire to their clients when the seasons are not favourable. However, with a couple of good seasons, grain growers may have the facility to consider break crops especially on acidic soils. This being the case, growers may consider triticale and if there is financial incentive, Berkshire. The research done by Dennett et al. (2013) is particularly encouraging in that if there is a food market for triticale, the spin-off for the feed industry may be positive.

Pig producers were keen to discuss the prospect of Berkshire being included in their diets. However, despite meeting together to discuss a contract price, they could not be convinced to price triticale at a level that would provide incentive for many producers to grow it.

Grain producers have been growing Berkshire since 2009. However, in recent years they have not grown it as extensively as expected due to a run of poor seasons. Further, due to a lack of segregation and incentive to declare Berkshire as a specific triticale variety, it would seem that there is very little grown. However, given seed distribution model results it could be suggested that there is more Berkshire grown than is publically known.

Berkshire is subject to PBR. However, as so little Berkshire is sold through official receival points and there is not the facility to actively segregate within the supply chain, there may be room for debate regarding continuing with this PBR.

7. Conclusion

In Western Australia triticale is an option for grain growers and buyers. Whilst it might grow well on acidic soils, grain growers are hesitant to grow it due to what they perceive to be a lack of financial incentive. Despite what feed formulations might suggest, buyers prefer to buy it at around $20 to $30/t less than what they are willing to pay for wheat. Given the grain growing substitutes available, triticale growers are generally price takers and hence have little incentive to produce triticale. If pig producers are serious about having triticale in their rations then they have to ensure supply.

Overall it can be concluded that whilst there is adequate communication within the supply chain, demand for Berkshire is spasmodic with price incentives being limited due to seemingly adequate supply of alternative grains. Further, supply of triticale can be irregular and after poor seasons is unlikely to be grown unless the producer has adequate resources to use it as a break crop or has a price incentive to grow it.

8. Recommendations

As a result of the outcomes from this study the following recommendations have been made:

1. Endorse triticale varieties as energy substitutes for wheat to encourage triticale demand;

2. Encourage feed buyers to communicate with triticale growers to stimulate supply;
3. Remove the PBR status from Berkshire;
4. Follow the progress of triticale as a food grain and use any positive developments to benefit feed grain.

9. Acknowledgements

The authors are grateful for the help received from all of the agronomists, grain growers, grain buyers, feed manufacturers and pig producers who helped out in this project.

10. References


Appendices

Appendix 1: Press release 2010

Pork CRC Media Release – March 31, 2010

BERKSHIRE A TRITICALE TREAT FOR PIGS

To encourage the 2010 growing of Berkshire, the new high yielding triticale, meetings of triticale growers, agronomists, pork producers and feed mills were recently hosted by Australia’s Pork Cooperative Research Centre (CRC), co-developer of the variety with The University of Sydney and the Grains Research and Development Corporation.

Berkshire was one of three new grain varieties from Pork CRC plant breeding projects released for commercial sowing during the 2009 season and now available for extensive release. The others were the field pea, Maki and the barley, Shepherd.

Berkshire seminar attendees were told by Pork CRC Program One Manager, Dr Ray King, that at an average digestible energy (DE) content of 13.9 MJ DE/kg, Berkshire contained about 0.5 MJ DE/kg more than the average energy in other triticale varieties, including Tahara.

“The higher DE content of Berkshire was confirmed by AusScan feed analysis on samples of Berkshire collected from around Australia during the current 2009/10 harvest, making it similar to the ‘average’ wheat,” Dr King explained.

The revolutionary AusScan technology, released by the Pork CRC last year, predicts DE content with an accuracy of ± 0.27 MJ/kg and is now available from major Australian feed testing laboratories.

Dr King urged pork producers and feed suppliers to routinely analyse grain to assist in purchasing decisions and to adjust their feed formulations to maximise productivity.

There is considerable variation in the nutrient value of grains, according to Dr King, with energy values varying by up to 4 MJ DE/kg within a cereal grain.

Following a limited release last year through Waratah Seeds, Berkshire was grown commercially in several pork producing regions, performing very well, while outyielding other triticales and often outyielding wheat grown on the same farm.

“There is anecdotal information from WA suggesting Berkshire yields, at three tonnes per hectare, were superior to wheat and other triticales,” Dr King said.

A controlled marketing system involving growers and end-users will enable pork producers and grain growers to benefit from Berkshire’s yield and quality advantages.

According to ABARE (2007), triticale comprised about 13% of the cereal grains in Australian pig diets, with wheat at 38%, barley at 30% and sorghum at 14%. About half a million tonnes of triticale is currently grown across Australia.

For more information about the new Pork CRC supported feed grains, Berkshire, Maki and Shepherd, interested grain growers and pork producers can contact Dr Ray King, Manager, Pork CRC Program One, ‘Securing more reliable and consistent supplies of protein and energy for pig diets’, Mob 0412 322 047 or Email r.h.king@bigpond.net.au

For specific agronomic advice regarding Berkshire, including preferred growing zones, disease resistance and management of stripe rust, growers should contact Waratah Seeds, The Seed Professionals, via their website www.waratahseeds.com.au or email info@waratahseeds.com.au

A second Pork CRC developed triticale variety, JRCT400, is on-line for release with Waratah Seeds, which is bulking up seed this season.

www.porkcrc.com.au

Authorised by Pork CRC and issued on its behalf by Brendon Cant & Associates, Tel 08 9384 1122.

MEDIA CONTACTS:
Dr Ray King, Manager, Pork CRC Program One, Mob 0412 322 047
Dr Roger Campbell, CEO, Pork CRC, Mob 0407 774 714.
Appendix 2: Press release 2012
Pork CRC Media Release – December 12, 2012

Berkshire Triticale A Growing Grain Option In 2013

Last season Dawson Bradford grew 500 hectares of Berkshire triticale at ‘Hillcroft Farms’ at Popanyinning in Western Australia’s Great Southern, where he mills all the feed for his 700 sow piggery.

An exclusive supplier of pigs to leading WA smallgoods manufacturer D’Orsogna Ltd., Mr Bradford must maximise his feed conversion ratio, hence being able to utilise Berkshire’s high digestible energy content of up to 13.9 MJ DE/kg (about 0.5 MJ DE/kg more than the average energy in other triticale varieties) is a big production plus.

To manage problems with frost, inherent in all triticale varieties, he planted Berkshire on high ground and to extend the flowering window beyond the September frost risk period grazed it from late June to early July.

Having trialled it now for four years, Mr Bradford has found he can sow late and graze without any yield penalty. After harvest straw is used for pig bedding or sold for export.

“I’ve achieved yields above three tonnes per hectare and while it hasn’t out performed barley here, it has done better than wheat,” Mr Bradford said.

He particularly values Berkshire’s agronomic traits and its flexible sowing date.

Berkshire triticale was bred through the Pork CRC to be a high yielding grain with a higher digestible energy content than contemporary varieties. It yields well, especially on an energy basis and supports excellent growth performance in pigs.

With financial backing from the pork industry, via the Pork CRC, the variety is now commercially available for planting in 2013.

Murdoch University Professor John Pluske, who leads a Pork CRC project to increase awareness of Berkshire triticale throughout the supply chain, said that because triticale was not widely grown in WA, it may not be an obvious crop for grain growers to consider in their rotations.

“All that we’ve been talking with grain growers, agronomists, grain buyers, feed manufacturers and pork producers about Berkshire because we believe it has benefits for the pig industry and also for the grain industry,” Professor Pluske said.

Long-term NVT trials in eastern Australia indicate Berkshire is a leading triticale variety.

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Long-term NVT trials in eastern Australia indicate Berkshire is a leading triticale variety.

While there wasn’t NVT data for Berkshire in WA, independent trials in the 2009/10 and 2010/11 seasons, showed average yields across several sites compared well to established wheat varieties, indicating Berkshire could be important as a break crop.

“Berkshire’s ability to handle acidic and waterlogged soils gives grain growers an alternative option for these soils, but also because it has performed well across soil types it could be considered as a replacement for wheat in some years,” Professor Pluske said.

If interested in Berkshire triticale or would like more information about the project, please contact Professor John Pluske by email J.Pluske@murdoch.edu.au

www.porkcrc.com.au

Authorised by Pork CRC and issued on its behalf by
Brendon Cant, Tel 08 9731 6739.

MEDIA CONTACT: Dr Roger Campbell, Pork CRC CEO, Mob 0407 774 714.

Appeared in:
11 Jan Australian Pork Newspaper
20 Dec The Farm Weekly
14 Dec The Countryman
14 Apr Pig-site
12 Dec Seed Quest http://www.seedquest.com/
12 Dec Get Livestock
12 Dec Pig 333 http://www.pig333.com/
12 Dec Fat Cow
12 Dec Get Small Farms
12 Dec All About Feed http://www.allaboutfeed.net/Home/News/
Appendix 3: Grower fact sheet for Berkshire

Have you considered Berkshire Triticale?

It is desirable for dedicated feed grains to have...
- a comparable yield to varieties grown for food...
- agronomic characteristics similar to varieties currently grown by producers...
- high digestible energy content...
- competitive price...

If you have any interest in a triticale variety then Berkshire might be the variety for you?

Pork CRC Project: Advancing Berkshire triticale supply for the Australian pig industry

Objective: To increase awareness of Berkshire triticale in the grain supply chain with the aim of increasing supply and demand.

* Trial results suggest that Berkshire can be competitive with existing wheat and barley varieties in terms of yield.

Average yields (t/ha) for Berkshire triticale and various wheat and barley varieties grown during the 2009/10 season at trial sites in Western Australia.

- Berkshire is suited to all soil types but can have a yield advantage over wheat and barley when grown in problem soil situations such as acidic soils (pH less than 4.5) that are high in aluminium (greater than 10% of the total cations) e.g. WA. Planting times and seeding rates are similar to wheat. When compared to wheat, it tends to be more competitive against ryegrass. For specific management, contact your local agronomist or see Wannan Seeds fact sheets at www.wannanseeds.com.au.

* In 2009/10 WA trials, for Berkshire, the average DE was 13.78 MJ/kg.

* Contact your local triticale trader to negotiate a competitive price for Berkshire.

A multidisciplinary project involving the CRC for High Integrity Australian Pork, Murdoch University, The Department of Agriculture and Food WA, and various members of the industry. For more information contact: Professor John Pleske (J.Pleske@Murdoch.edu.au) or Dr Bruce Mullan (Bmullan@agr.wa.gov.au).
Appendix 4: DEPI descriptions of triticale varieties

DEPI (2013) provided the following descriptions of triticale varieties (Plant Breeders Rights apply); the End Point Royalty (EPR) for 2013 is quoted $/tonne ex-GST; dual-purpose triticales can be grazed early and then allowed to produce grain or cut for hay.

**BERKSHIRE**
A mid-season awned variety with good straw strength. Resistant to leaf rust, moderately resistant to stem rust and moderately susceptible to stripe rust. Has been purpose bred for feed quality traits for pigs by the University of Sydney and Pork CRC, registered 2009. Marketed by Waratah Seed Co. EPR $2.50.

**BOGONG**
An early to mid-season fully awned variety. Higher yielding than Tahara with good resistance to stem and leaf rust but MS to stripe rust and susceptible to CCN. Bred by University of New England, registered 2009. Marketed by Viterra. EPR $2.20.

**CANOBOLAS**
Early to mid-season awned variety with stiff straw, shorter than Tahara. A widely adapted spring variety with acid soil tolerance. Canobolas has resistance to stem and leaf rust and MSS to stripe rust. Bred by the University of New England, registered 2009. Marketed by Viterra. EPR $2.20.

**CHOPPER**
An early maturing, awned semi dwarf variety which resists lodging in high yielding environments. Has good grain quality and performs best in short growing seasons or late sowing situations. Is resistant to CCN and MSS to stripe rust. Bred by AGT (TSA0219), released in 2010 and marketed by Waratah Seed Co and AGT. EPR $3.

**FUSION**
Fusion is a mid-season variety (similar to Tahara) and was introduced in 2013. It is CCN-resistant and is reputed to yield well even under dry conditions or a quick finish to the season. It is a fully awned grain only triticale. A moderately tall variety that yields well in dry or sudden finishes. CCN resistance, good resistance to stem and leaf rust and MRMS to stripe rust. Tested as TSA0291, released in 2012 and marketed by Waratah Seed Co and AGT. EPR $3.

**GOANNA**
An early to mid-season, fully awned grain only triticale. CCN resistance, good resistance to stem and leaf rust and MRMS to stripe rust. Released in 2011 by Cooper & Elleway.

**HAWKEYE**
A mid-season maturing, fully awned, spring variety with broad adaptation. This variety produces large grain with low screenings, and has resistance to CCN, good resistance to stem and leaf rust and MSS to stripe rust. Released 2007 and marketed by Waratah Seed Co and AGT. EPR $2.50.

**JAYWICK**
A medium maturing, fully awned spring variety which has displayed good yields in tough finishing seasons. Also produces large grain with low screenings. Resistant to CCN, good
resistance to stem and leaf rust and MRMS to stripe rust. Released 2007 and marketed by Waratah Seed Co and AGT. EPR $2.50.

TAHARA
A variety that has been widely grown for many years because of its reliability across a range of environments, but now outclassed by newer options. It may lodge in high yielding situations, and has resistance to CCN, RMR to stem rust, R to leaf rust and MS to stripe rust. Suited to most districts with rainfall up to 550mm. Released 1987 by the forerunner of the Victorian DPI.

TICKIT
A widely adapted variety with straw that is shorter and stronger than Tahara and with similar maturity and grain quality. MS to stripe rust and resistant to CCN. An older variety generally outclassed by newer options. Registered 1999, seed freely available.

YOWIE
A medium to tall mid-season grain variety that is fully awned and white-chaffed. Good resistances to all rusts and full resistance to CCN. Released in 2010, seed available from Cooper & Elleway.

ENDEAVOUR
Long season variety with similar maturity to Breakwell, A semi-awnless variety with excellent dry matter production and grain recovery after grazing. Resistant to all rusts. Registered 2008 and marketed by Waratah Seed Co.

RUFUS
A mid-season maturing variety, with a tall growth habit and reduced awns which is favoured for hay production. Is CCN resistant and MS to stripe rust. Grain yields in higher rainfall regions have been superior to Tahara but may also cause lodging. Released in 2005 by University of New England.

TOBRUK
With a strong winter habit Tobruk is a dual purpose or long season grain only variety with excellent grain yield. Resistant to stem and leaf rust but MSS to stripe rust. Earlier flowering than Breakwell and Endeavour. Released 2007 and marketed by Waratah Seed Co.

TUCKERBOX
Tuckerbox is a late-medium season, tall, high tillering variety with reduced awn head type, which may be grown for forage or grain. So far, it has demonstrated a good resistance to all rusts and CCN. Released in 2009 and marketed by Seed Distributors.

YUKURI
A reduced awn type of medium to late season maturity, it is RMR to stripe rust but is susceptible to CCN. Yukuri is a fodder type option which produces good quality hay and silage. As a grain crop it is best suited to environments with 450mm plus rainfall. Registered 2005, marketed by Seed Distributors.
Appendix 5: Berkshire nutritional profile 18th April 2013

A Nutritional Profile of Berkshire (Triticale)

Table 1. AusScan NIR results for the triticale cv. Berkshire

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Bottom 10%</th>
<th>Bottom 25%</th>
<th>Median</th>
<th>Top 25%</th>
<th>Top 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIG Faecal DE (MJ/kg as fed)</td>
<td>&lt;12.70</td>
<td>&lt;13.20</td>
<td>13.46</td>
<td>&gt;13.80</td>
<td>&gt;14.00</td>
</tr>
<tr>
<td>PIG Ileal DE (MJ/kg as fed)</td>
<td>&lt;9.40</td>
<td>&lt;10.90</td>
<td>11.45</td>
<td>&gt;12.10</td>
<td>&gt;12.70</td>
</tr>
<tr>
<td>Total Insoluble NSP (% DM)</td>
<td>&lt;8.20</td>
<td>&lt;9.50</td>
<td>10.98</td>
<td>&gt;11.50</td>
<td>&gt;13.00</td>
</tr>
<tr>
<td>Total Soluble NSP (% DM)</td>
<td>&lt;1.30</td>
<td>&lt;1.60</td>
<td>1.85</td>
<td>&gt;2.00</td>
<td>&gt;2.80</td>
</tr>
<tr>
<td>Insoluble Arabinoxylans (% DM)</td>
<td>&lt;5.10</td>
<td>&lt;6.10</td>
<td>7.08</td>
<td>&gt;7.40</td>
<td>&gt;8.00</td>
</tr>
<tr>
<td>β-glucans (% DM)</td>
<td>&lt;0.35</td>
<td>&lt;0.62</td>
<td>0.66</td>
<td>&gt;0.72</td>
<td>&gt;0.97</td>
</tr>
<tr>
<td>Hydration Capacity (%)</td>
<td>&lt;44.3</td>
<td>&lt;49.9</td>
<td>56.6</td>
<td>&gt;63.6</td>
<td>&gt;76.9</td>
</tr>
<tr>
<td>Crude Fibre (% DM)</td>
<td>&lt;2.7</td>
<td>&lt;3.1</td>
<td>3.2</td>
<td>&gt;3.4</td>
<td>&gt;4.0</td>
</tr>
<tr>
<td>Acid Detergent Fibre (% DM)</td>
<td>&lt;2.9</td>
<td>&lt;3.3</td>
<td>3.8</td>
<td>&gt;4.8</td>
<td>&gt;4.89</td>
</tr>
<tr>
<td>Englyst Neutral Detergent Fibre (% DM)</td>
<td>&lt;9.1</td>
<td>&lt;13.0</td>
<td>15.9</td>
<td>&gt;16.8</td>
<td>&gt;18.7</td>
</tr>
<tr>
<td>Total Starch (% DM)</td>
<td>&lt;60.0</td>
<td>&lt;62.1</td>
<td>63.3</td>
<td>&gt;66.0</td>
<td>&gt;67.5</td>
</tr>
</tbody>
</table>

Source: AUSSCAN® Calibration result interpretation (Version 3 October 2011)

Table 2. AusScan NIR results\(^1\) for five samples of Berkshire\(^2\)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIG Faecal DE (MJ/kg as fed)</td>
<td>13.71</td>
<td>13.87</td>
<td>14.18</td>
<td>0.173</td>
<td>13.90</td>
</tr>
<tr>
<td>PIG Ileal DE (MJ/kg as fed)</td>
<td>12.16</td>
<td>12.37</td>
<td>14.25</td>
<td>0.875</td>
<td>12.72</td>
</tr>
<tr>
<td>Total Insoluble NSP (% DM)</td>
<td>6.60</td>
<td>7.01</td>
<td>8.75</td>
<td>0.877</td>
<td>7.46</td>
</tr>
<tr>
<td>Total Soluble NSP (% DM)</td>
<td>-0.59</td>
<td>0.54</td>
<td>0.87</td>
<td>0.576</td>
<td>0.36</td>
</tr>
<tr>
<td>Insoluble Arabinoxylans (% DM)</td>
<td>3.08</td>
<td>4.26</td>
<td>5.80</td>
<td>1.071</td>
<td>4.53</td>
</tr>
<tr>
<td>β-glucans (% DM)</td>
<td>-0.05</td>
<td>0.24</td>
<td>0.96</td>
<td>0.443</td>
<td>0.41</td>
</tr>
<tr>
<td>Hydration Capacity (%)</td>
<td>41.42</td>
<td>43.64</td>
<td>53.99</td>
<td>5.133</td>
<td>45.03</td>
</tr>
<tr>
<td>Crude Fibre (% DM)</td>
<td>2.43</td>
<td>2.87</td>
<td>3.44</td>
<td>0.394</td>
<td>2.83</td>
</tr>
<tr>
<td>Acid Detergent Fibre (% DM)</td>
<td>2.63</td>
<td>2.89</td>
<td>3.45</td>
<td>0.317</td>
<td>2.92</td>
</tr>
<tr>
<td>Englyst Neutral Detergent Fibre (% DM)</td>
<td>13.40</td>
<td>14.28</td>
<td>17.50</td>
<td>1.746</td>
<td>14.86</td>
</tr>
<tr>
<td>Total Starch (% DM)</td>
<td>63.86</td>
<td>69.08</td>
<td>72.37</td>
<td>3.641</td>
<td>67.77</td>
</tr>
</tbody>
</table>

Analyses completed 8th April 2013 (DAFWA)

\(^1\)Only minimum, median and maximum results are provided due to the number of samples tested n=5

\(^2\)The five samples were harvested in the central medium rainfall region in WA during the 2012/13 season.
Table 3. Amino acid content (g/kg air-dry basis) of five samples of Berkshire

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Min</th>
<th>Median</th>
<th>Max</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>107.94</td>
<td>112.50</td>
<td>130.02</td>
<td>8.951</td>
<td>114.55</td>
</tr>
<tr>
<td>Aspartic acid</td>
<td>7.18</td>
<td>7.41</td>
<td>8.29</td>
<td>0.452</td>
<td>7.52</td>
</tr>
<tr>
<td>Glutamic acid</td>
<td>27.54</td>
<td>29.27</td>
<td>34.68</td>
<td>2.783</td>
<td>29.90</td>
</tr>
<tr>
<td>Serine</td>
<td>5.50</td>
<td>5.74</td>
<td>6.60</td>
<td>0.450</td>
<td>5.82</td>
</tr>
<tr>
<td>Histidine</td>
<td>2.49</td>
<td>2.80</td>
<td>2.92</td>
<td>0.174</td>
<td>2.75</td>
</tr>
<tr>
<td>Glycine</td>
<td>4.61</td>
<td>4.64</td>
<td>5.57</td>
<td>0.415</td>
<td>4.83</td>
</tr>
<tr>
<td>Threonine</td>
<td>3.94</td>
<td>4.02</td>
<td>4.54</td>
<td>0.240</td>
<td>4.14</td>
</tr>
<tr>
<td>Cysteine-X</td>
<td>2.80</td>
<td>2.96</td>
<td>3.29</td>
<td>0.206</td>
<td>2.99</td>
</tr>
<tr>
<td>Alanine</td>
<td>4.36</td>
<td>4.54</td>
<td>5.22</td>
<td>0.335</td>
<td>4.64</td>
</tr>
<tr>
<td>Arginine</td>
<td>5.53</td>
<td>5.78</td>
<td>6.42</td>
<td>0.377</td>
<td>5.88</td>
</tr>
<tr>
<td>Tyrosine</td>
<td>3.30</td>
<td>3.51</td>
<td>3.61</td>
<td>0.126</td>
<td>3.50</td>
</tr>
<tr>
<td>Valine</td>
<td>4.84</td>
<td>5.05</td>
<td>5.83</td>
<td>0.388</td>
<td>5.15</td>
</tr>
<tr>
<td>Methio-nine</td>
<td>1.97</td>
<td>2.05</td>
<td>2.28</td>
<td>0.126</td>
<td>2.11</td>
</tr>
<tr>
<td>Phenyl-alanine</td>
<td>5.00</td>
<td>5.20</td>
<td>6.14</td>
<td>0.469</td>
<td>5.34</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>3.73</td>
<td>3.86</td>
<td>4.56</td>
<td>0.343</td>
<td>3.98</td>
</tr>
<tr>
<td>Leucine</td>
<td>7.29</td>
<td>7.52</td>
<td>8.89</td>
<td>0.656</td>
<td>7.76</td>
</tr>
<tr>
<td>Lysine</td>
<td>3.36</td>
<td>3.42</td>
<td>4.45</td>
<td>0.461</td>
<td>3.64</td>
</tr>
<tr>
<td>Proline</td>
<td>13.39</td>
<td>14.01</td>
<td>16.84</td>
<td>1.347</td>
<td>14.60</td>
</tr>
</tbody>
</table>

Analyses completed 2nd April 2013 (Analyst: MMcGrath, DAFWA)

1 The five samples were harvested in the central medium rainfall region in WA during the 2012/13 season
**Appendix 6: Grain Link contract**

---

**GRAIN LINK WA PTY LTD**

**ABN 30 089 314 572**  **Phone 9258 9781**  **Fax 9358 4587**

**HECTARE BASED BERKSHIRE TRITICALE CONTRACT**

**NO PRICE ESTABLISHED OR NPE AT TIME OF CONTRACT**

**CONTRACT NUMBER :**

**DATE : XXXXXX**

**THIS CONFIRMATION MADE BETWEEN:**

**NAME : GRAIN LINK WA**

**ADDRESS : PO BOX 757**

**: KALAMUNDA WA 6626**

(hereinafter called the "buyer") who agrees to buy

AND:

**NAME : …………………………………………**

**ADDRESS : …………………………………………**

**…………………………………………**

**:…………………………………………**

**ABN  :…………………………………………**

(hereinafter called the “seller”) who agrees to grow and sell the

undermentioned product subject to the terms and conditions contained herein

1. **PRODUCT  …………………  BERKSHIRE TRITICALE**
2. **QUALITY:………………….  STDCBH BINNING GRADE STANDARD**
3. **HECTARES PLANTED…..  ANTICIPAED YIELD AND SUBSEQUENT PRODUCTION**
4. **PRICE:………………………..  AS PER SPECIAL CONDITIONS PAGE**
5. **LEVIES:…………………………..  AS PER INDUSTRY AT TIME OF PRICE SETTING**
6. **PAYMENT TERMS:……………   30 Days End Of Week Following Delivery**
7. **DELIVERY PERIOD:…………..  AT BUYERS CALL**
8. **DELIVERY POINT:…………….  PERTH METRO AREA TO BE CONFIRMED**
9. **SPECIAL CONDITIONS……….  AS PER SPECIAL CONDITIONS PAGE**
10. **TRADE RULES AS PER GTA**  

   **Incorporation of GTA Trade & Dispute Resolution Rules:** This contract expressly incorporates the GTA Trade Rules and Dispute Resolution Rules in force at the time of this contract, under which any dispute, controversy or claim arising out of, relating to or in connection with this contract, including any question regarding its existence, validity or termination, shall be resolved by arbitration.

11. **ARBITRATION:** If any disputes arise between the Seller and the Buyer concerning the performance or observations by either party of the provisions of the Contract, the matter and all questions incidental thereto shall be referred to Arbitration, under the provisions of the GTA Arbitration Rules current at the date of contract.

Please sign and return one copy within 24 hours. If not received within that time, the contract, failure to do so constitutes acceptance of the above. The seller confirms that he/she is registered for GST with the above mentioned ABN number and hereby agrees to the buyer issuing a recipient created tax invoice for the duration of this contract

**SELLER      BUYER**

<table>
<thead>
<tr>
<th>Signature</th>
<th>Signature</th>
</tr>
</thead>
</table>

**Name**

— GRAIN LINK WA ——

---

Grain Link WA is obliged to deduct 48.5% withholding tax if an ABN is not provided or this confirmation is not signed and returned.
GRAIN TRADE AUSTRALIA (GTA) STANDARD TERMS AND CONDITIONS

TRADING RULES: This Contract is subject to the Trade Rules of GTA currently in effect, except to the extent the same are in conflict with the Terms and Conditions expressed herein, with such Rules forming an integral part of the Contract and of which both parties hereto shall be deemed to be cognisant.

TIME: All stipulations set forth in the Terms of Trade as to "TIME" are of the essence.

QUANTITY: Unless otherwise stated, all quantities shall be expressed metrically and to the nearest one/hundredth [1/100] of a metric tonne.

QUANTITY TOLERANCE: The Seller shall have the option of delivering five percent [5%] or twelve [12.00] metric tonnes, whichever is the lesser quantity, more or less than the contractual quantity at the Contract price. This variation of five percent [5%] or twelve [12.00] tonnes is hereinafter referred to as the "Tolerance".

WEIGHTS: Unless specifically agreed otherwise, destination weights, which shall be determined by qualified personnel, shall be the basis of trade. If these are not available, loading point, government or Registered Public Weighbridge weights shall be accepted. Errors in weighbridge tickets in all cases shall be excepted.

QUALITY GRADES: Unless specifically agreed otherwise, Destination Quality Grades shall be on the basis of trade, which shall be determined by qualified personnel according to sampling and analyses procedures established by GTA. If these are not available, Loading Point Quality Grades shall be accepted.

CHEMICAL AND PESTICIDE RESIDUES: The Seller warrants that the commodity complies with all State and Federal Laws and requirements relating to chemical and pesticide residues and specific government designated maximum residue levels.

CONVEYANCE AND DELIVERY INSTRUCTIONS: Unless otherwise agreed, the Seller shall have the right of conveyance.

INTEREST: If any payment is not made on or before the due date for payment, interest shall be payable at the rate selected. If there is no due date for payment, interest shall be payable if there has been an unreasonable delay in payment. Interest payable shall be appropriate to the currency involved. If the amount of interest is not mutually agreed, interest will be payable at a rate of 1.5% per calendar month, calculated daily.

OWNERSHIP AND PASSING OF TITLE: Risk in any goods supplied by the Seller to the Buyer shall pass to the Buyer when the goods are in the possession of the Seller however title shall not pass until payment in full has been received by the Seller. Until full payment is received the Buyer and/or its agents and 3rd parties hold the goods as bailees only. On breach of any payment terms, the Buyer on its own behalf and on behalf of its agents and 3rd parties authorises the Seller to enter any premises and retake possession of the goods without notice to the Buyer, its agents and 3rd parties.

Where the goods have been comiled with other goods, the Buyer becomes an owner in common of the bulk goods and the undivided share of the Seller shall be such share as the quantity of Seller's goods bears to the quantity of the goods in the bulk.

Until such time as the Seller has received payment in full, any on-sale by the Buyer is made as the Seller's agent and the Buyer holds the proceeds of any on-sale of the Goods as trustee for and on behalf of the Seller and must account to the Seller for those proceeds, on demand. Where at the time of default in any payment terms to the Seller the Buyer has not received proceeds of any on-sale the Seller is expressly authorised to receive proceeds of on-sale direct from the Buyer's customer.

REJECTION: A Buyer shall not be entitled to reject goods as not being in accordance with description or sample if those goods are of a quality superior or equal to that contracted for, provided that goods are otherwise in accord with the Contract description.

FINALITY: All adjustments or compensation claimed based on defect of quality or condition or weights which shall be apparent upon reasonable inspection must be advised within five [5] business days after unloading or presentation of appropriate documents and must be formally confirmed by written notice, letter or facsimile within thirty [30] consecutive days of delivery of the consignment.

FAILURE TO PERFORM: Failure to perform in keeping with the Terms and Conditions of a Contract shall be grounds for the refusal only of such Delivery(ies) or Shipment(s) in default, and not for the recession of the entire Contract or any other Contract between the Buyer and Seller.

DEFAULT: In the event of Default in fulfillment of Contract by either party, the other at their discretion shall have the right, after giving written notice by letter, or facsimile, or telex, or by email to sell or purchase, as the case may be, against the Defaulter and the Defaulter shall make good the loss, if any, on such purchase or sale.

If the Buyer or Seller suspend payments of debts, or convenes or holds a meeting for the purpose of considering a resolution that the company be wound up or go into liquidation, or has a receiver appointed, or hold a meeting for the purpose of considering a resolution that the company be wound up or go into liquidation, such Buyer or Seller shall be deemed to be in Default.

NOTICES: All notices given under these GTA Trading Rules shall be given by written letter delivered by hand on the day of writing, or by facsimile, or by telex, or by email or by other method of rapid written communication. Any notices received after 1700 hours local time on a business day shall be deemed to have been received on the business day following. A notice to a party's Brokers or Agent shall be deemed a notice under these GTA Trading Rules. In case of delays, all notices shall be passed on without delay by Buyers to their respective Sellers or vice versa.

FORCE MAJEURE: Neither the Buyer nor the Seller shall be responsible for delay in delivery of goods or any part thereof occasioned by action by any act of God, fire, wind, explosion, power failure, war, embargo, act of government, strike (including dock and/or shipping strike), lock-out, combination of workers, or civil commotion which is not due to said party's own acts or negligence. The loss of a commodity due to production risks or crop failure does not constitute a condition of Force Majeure.

DISPUTES: Any party or parties who have entered into Terms of Trade subject to GTA Trade Rules shall be entitled to refer any disputes arising out of such contract, and which cannot be resolved between the parties, to GTA for Arbitration.

ARBITRATION: If any dispute arises out of or relates to this Contract or the breach, termination or subject matter thereof, the dispute shall be submitted to and settled by Arbitration in accordance with GTA Dispute Resolution Rules in the edition current at the date of the establishment of the Terms of Trade in the Contract, such rules forming an integral part of the Contract and of which both parties hereto shall be deemed to be cognisant.

Neither party to a dispute, nor any persons claiming under either of them, shall bring any action or other legal proceedings against the other in respect to any such dispute until arbitrated in accordance with GTA Dispute Resolution Rules.

DOMICILE: This Contract and these GTA Trade Rules are governed by and shall be construed to be in accordance with the law for the time being enforced in Australia and in the State or Territory in which the transaction is executed (i.e. goods conveyed and title passed). Performance of all Contracts under these Trade Rules are subject to orders, rules and regulations of all government agencies, and to all causes, except as limited herein.

RCTI: Recipient Created Tax Invoice - Reference on the front of this form provides for the grower (seller) to authorise the buyer to issue the RCTI on his behalf. This request also requires the sellers signature.
SPECIAL CONDITIONS

1 PRICE: Price Based on APW2 Highest Average Free in Store Price less $20/mt between 9th Dec and Dec 23rd Price to be confirmed 1st Jan 2014

2 ON FARM STORAGE: Storage Paid @ $2.50/mt/mth from Jan 1st 2014

3 EXPECTED TONNAGE: The Grower should let Grain Link WA know of the expected tonnage by Oct 1st

4 DELIVERY TONNAGE: The Grower should let Grain Link WA know a Delivery Tonnage by Nov 15th

5 HECTARES PLANTED: The Grower is obliged to let Grain Link WA know of any changes to the planted Contracted Hectares.

PRICE SETTING EXPLAINED:

Daily Grain APW2 FIS Price quoted between 9th December and 23rd December average taken over this period.
Berkshire Price FIS or Delivered End User Perth Metro Area APW Price Less $20/mt
All other Varieties Perth Metro Area Price less $30/mt

NETT PRICE TO GROWER

EG: APW2 Average Price from 9th Dec 2013 to 23rd Dec 2013 equals $282.00/mt
Less $20/mt Discount $20.00
Less Free In Store $11.75
Less Applicable Freight $25.00/mt (Average)
Less Fed & State Levies $2.92

NETT PAID $222.33
Appendix 7: Intentions to grow Berkshire

Dear XXXX

Hope harvest is progressing well.

We have been contacted by a consultant working for the Australian Pork industry regards broad acre adoption of Berkshire a new Triticale for WA. It seems to stack up very well against the older varieties and has been bred specifically for the Pork Industry.

We are keen to know if you are growing Triticale next season and if so if you might be interested in trying some Berkshire within your program.

If you are at all interested we can send you out some trial results and a fact sheet on the variety. Would you mind filling in the questions below and faxing back on 9358 458.

(Please circle)

ARE YOU GROWING TRIT IN SEASON 2013 – 2014 yes no
WOULD YOU LIKE TO TRY BERKSHIRE yes no
HOW MANY HECTARES (APPROXIMATELY) ......................Ha’s

Thanks XXXXXX

Kind Regards

Andrew

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PROJECT 4B- 115: ADVANCING BERKSHIRE TRITICALE SUPPLY FOR THE AUSTRALIAN PIG INDUSTRY

Appendix 8: APSA Papers

Final Report prepared for the Co-operative Research Centre for High Integrity Australian Pork

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June 2014
Digestible energy content for Berkshire triticale varies depending on season and site

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A major aim associated with the development of Berkshire, a triticale variety propagated with funding from the Pork CRC, was to produce a feed grain with a high level of digestible energy (DE) and hence an ingredient that offered cost efficiencies in diet formulations. Berkshire has now been registered as a Plant Breeders’ Rights (PBR) variety and has been grown in New South Wales, Victoria, South Australia and Western Australia. However, little has been documented in regard to the variation in DE content of Berkshire across these growing regions.

Kim et al. (2005) concluded that the DE content of Western Australian wheats fed to weaner pigs varied according to the variety and growing region. It could therefore be hypothesised that the DE content of Berkshire would also vary depending on growing conditions. As a corollary to a larger plant-breeding project (see Kim et al., 2011), and using NIR AusScan, data pertaining to the faecal DE content of Berkshire were analysed from 239 samples grown at 35 different sites in New South Wales, South Australia, Victoria and Western Australia during the 2009/10 season.

The DE value ranged from 13.22 MJ/kg to 14.34 MJ/kg. A single factor analysis of variance (ANOVA) indicated a significant difference in the DE values between each of the States (P<0.01), except for Victoria and Western Australia (Figure 1). Removing the three outliers from the Victorian data set did not alter this result. There was also a difference (P<0.01) in the DE recorded between sites within each State. For example, in Western Australia the mean DE content for the most northern trial site, Northampton, was 13.84 MJ/kg whilst that of the most southern site, Coomalbidgup, was 13.64 MJ/kg.

Figure 1. The faecal DE content (MJ/kg) for Berkshire grown in the 2009/10 season at various trial sites in: New South Wales (○); South Australia (●); Victoria (★); and Western Australia (△).

In Australia, these data are the first known to demonstrate that the DE content of triticale is variable according to site. Season and subsequently yield may also be important factors in determining DE content. Data taken from samples grown at Dandaragan in WA, for example, indicated that the mean DE content for the 2009/10 season was 13.43 MJ/kg whilst that for the 2010/11 season was 13.73 MJ/kg. Further research would be required to explain this variation. This paper reinforces the need for objective energy content testing to maximise efficiencies in feed formulation and production.


Supported in part by Pork CRC Limited Australia.
Why pork producers should consider the value of triticale

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In Australia, the triticale price is generally established through negotiation in a specific market as opposed to other grains where price is less obscure, for example, published as daily and forecast prices. Mostly, grain growers are price takers so may consider market price history and forecasts when deciding to grow a particular crop. In the case of triticale where such information can be difficult to obtain, uncertainty associated with price and a reliable market can result in grain growers selecting alternative crops.

One way to reduce price risk associated with triticale is to link its price to wheat. There is evidence in the literature (e.g., Beltranean et al., 2008) that suggests that when triticale is substituted for wheat in a diet, pigs do not reduce their feed intake or weight gain, and feed efficiency may improve. There may be reason therefore for the triticale price to be equivalent to the price of wheat (whatever grade is available to pork producers) because pork producers may not be worse off if they buy either. However, most often in Australia pork producers expect to pay a lower price for triticale than wheat.

The effect of a lower price is relevant for grain growers in terms of gross margin. Typical variable costs for growing wheat and triticale in wheat belt regions of Western Australia and various grain prices were incorporated into a desktop experiment involving gross margin analysis. By taking a May 2013 daily price for ASW wheat, $306/t, and reducing it by $20/t and $5/t (to simulate representative triticale prices), an estimation of the percentage change in gross margin from growing triticale as opposed to wheat can be made. A scenario involving reducing the wheat price to a level whereby growing triticale becomes economically unviable was also investigated in this study.

Under this arrangement and given the price of wheat was $306/t, growing triticale, priced at $286/t, instead of wheat would result in a percentage drop in gross margin for the grain grower from around 10% to 18% if yield was below 2t/ha (Figure 1). If the yield was above 2t/ha or if the price reduction for triticale was only $5/t, the percentage fall in gross margin would not be as dramatic. When a lower base price of $220/t for ASW wheat was considered, triticale priced at $200/t would result in yields below 0.9t/ha not being economically viable. Given a yield greater than 0.9t/ha, the percentage decrease in gross margin would be between 15% and 70%. If triticale was priced at $215/t, growing it in low yielding regions instead of wheat would again be questionable whilst in higher yielding areas a grain grower may consider it if there were sufficient agronomic benefits from growing triticale.

Agronomic benefits, for example, a yield advantage of triticale over wheat of 2% when the price was high ($306/t) and the discount only 5%, could result in a viable option for grain growers. However the 12% yield advantage necessary to compensate for a low price ($220/t) and a discount of $20/tonne for triticale would likely be unobtainable for grain growers. The results from this paper suggested that it would not be economically rational for grain growers to grow triticale when the price relative to wheat, and/or triticale yield, are low. To ensure future supply of this grain, the value of triticale in pig rations should be considered if pork producers wish to be proactive in negotiating a price with grain growers that will induce them to grow it.